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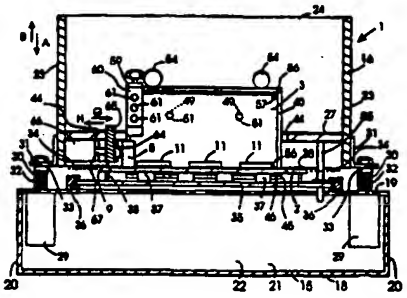
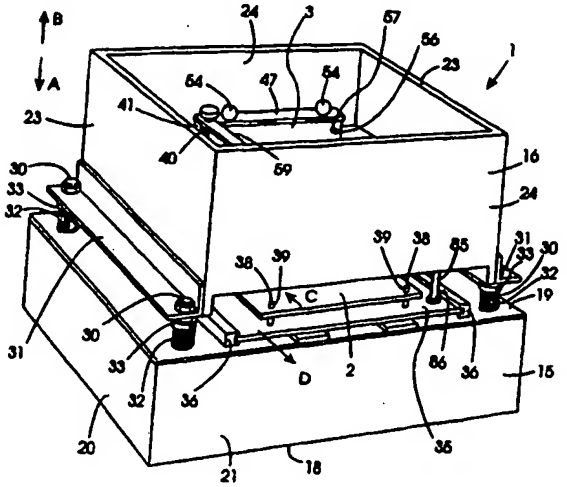
(54) Title: A TEST FIXTURE

(57) Abstract

A test fixture (1) for connecting a mother board (2) to test equipment for testing the mother board (2) connected to a reference daughter board (3). The test fixture (1) comprises a first platform (35) for carrying the mother board (2) which is slidably carried on a base box (15) between a loading position and a test position. A main carrier housing (16) is moveable in the direction of the arrow A from an inoperative to a test position. A first connector (63) extends downwardly from a sub–base (27) of the carrier housing (16) for engaging corresponding connectors (10) of the mother board (2) when the carrier housing (16) is in the test position. The daughter board (3) is carried on a second platform (40) in the carrier housing (16) and is moveable in the direction of the arrow E from an inoperative to a test position for engaging a connector socket (11) on the daughter board (3) with corresponding tab connectors (5) of the mother board (2). A carrier arm (65) in the carrier housing (16), which carries second connectors (64) is moveable in the direction of the arrow G from an inoperative position to a test position for engaging the second connector (64) with corresponding connectors (8) of the mother board (2).





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"A test fixture"

The present invention relates to a test fixture for testing printed circuit boards, and in particular, for testing one of a first printed circuit board and a second printed circuit board, with the other of the first and second printed circuit boards being connected to the printed circuit board under test, and in particular, though not limited to a test fixture for testing a mother board with a daughter board connected to the mother board, where the daughter board is a reference board, or for testing a daughter board when the daughter board is connected to a mother board, and the mother board is a reference board.

Computers, for example, personal computers comprise a mother board and a number of daughter boards connected to the mother board. Some of the daughter boards may be connected to the mother board when the personal computer is being sold, and provision in general, is made on the mother board, for subsequently connecting daughter boards if one wishes to expand the capabilities of the personal computer at a later stage. It is essential that prior to assembling the computer that the mother board and daughter boards be tested. This, typically is carried out by applying various test signals to specific connectors and locations of the respective boards, and monitoring outputs from other connectors or other specific locations on the board. In general, the daughter boards and mother boards are separately tested. Such tests, are of limited value, since in general, they only test certain critical aspects of the board under test, the entire functioning of the board is not tested, and furthermore, the boards are tested individually, and are not connected to other boards, to which in normal operation they would be connected. This, is not a particularly satisfactory method of testing printed circuit boards.

There is therefore a need for a test fixture for testing one of two printed circuit boards when the two printed circuit boards are

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connected with each other.

The present invention is directed towards providing such a test fixture.

According to the invention there is provided a test fixture for testing one of a first printed circuit board and a second printed circuit board, with the other of the first and second printed circuit boards being connected to the printed circuit board under test, characterised in that the test fixture comprises

a support means,

a first carrying means supported on the support means for carrying the first printed circuit board with the first printed circuit board lying in a first plane,

a second carrying means supported on the support means for carrying the second printed circuit board with the second printed circuit board lying in a second plane,

at least one of the first and second carrying means being moveable relative to the other for releasably electrically connecting the first and second printed circuit boards with each other, and

a connecting means supported on the support means for releasably electrically connecting the printed circuit board of the first and second printed circuit boards under test to test equipment,

at least one of the connecting means and the carrying means of the first and second carrying means for carrying the printed circuit board under test being moveable relative to the other for releasably electrically connecting the connecting means with the printed circuit board under test.

Preferably, the first carrying means is moveable with rectilinear motion in a plane parallel to the first plane between a loading position for facilitating loading of the first printed circuit board onto the first carrying means and a test position in which the first printed circuit board is tested.

In one embodiment of the invention the support means comprises a base and a main carrying means, the first carrying means being carried on the base.

In another embodiment of the invention the main carrying means is moveably mounted on the base and is moveable with rectilinear motion relative to the base in a plane perpendicular to the first plane between an inoperative position and a test position.

In one embodiment of the invention the second carrying means is moveable with rectilinear motion in a plane parallel to the first plane between an inoperative position and a test position so that when the first and second carrying means are in their respective test positions, the first and second printed circuit boards are electrically connected.

In an alternative embodiment of the invention the second carrying means is moveable with rectilinear motion in a plane perpendicular to the first plane between an inoperative position and a test position.

In one embodiment of the invention the first carrying means is disposed relative to the second carrying means so that the respective first and second planes are at an angle to each other. Alternatively, the first carrying means is disposed relative to the second carrying means so that the respective first and second planes are perpendicular to each other.

In one embodiment of the invention the direction of motion of the second carrying means is parallel to the direction of motion of the first carrying means. Alternatively, the direction of motion of the second carrying means is perpendicular to the direction of motion of the first carrying means.

Preferably, a first drive means is provided for moving the main carrying means relative to the base.

Advantageously, a second drive means is provided for moving the second carrying means with the rectilinear motion parallel to the first plane.

In another embodiment of the invention the second carrying means is mounted on the main carrying means and is moveable with the main carrying means with the rectilinear motion perpendicular to the first plane, and in which case, the second drive means is mounted on the main carrying means.

In one embodiment of the invention the connecting means comprises a first connecting means, the first connecting means being moveable with rectilinear motion in a plane perpendicular to the first plane between an inoperative position and a test position for electrically engaging the first printed circuit board.

In another embodiment of the invention the first connecting means is mounted on the main carrying means and is moveable with the main carrying means between the inoperative position and the test position.

In a further embodiment of the invention the connecting means comprises a second connecting means, the second connecting means being moveable relative to the first carrying means with rectilinear motion in a plane parallel to the first plane between an inoperative position and a test position for electrically engaging the first printed circuit board.

In one embodiment of the invention the direction of motion of the second connecting means is perpendicular to the direction of motion of the first carrying means. Alternatively, the direction of motion of the second connecting means is parallel to the direction of motion of the first carrying means.

In one embodiment of the invention the second connecting means is mounted on the main carrying means and is moveable between the

inoperative position and the test position relative to the main carrying means. Alternatively, the second connecting means is mounted on the base and is moveable between the inoperative position and the test position relative to the base.

Preferably, a third drive means is provided for moving the second connecting means between the inoperative position and the test position.

In one embodiment of the invention the third drive means is mounted on the base. Alternatively, the third drive means is mounted on the main carrying means.

In one embodiment of the invention the second carrying means comprises a second carrier platform for receiving the second printed circuit board.

In another embodiment of the invention the second carrying means comprises a second carrier member for carrying the second carrier platform, the second carrier platform being moveable relative to the second carrier member with the rectilinear motion parallel to the first plane.

In a further embodiment of the invention the second drive means moves the second carrier platform relative to the second carrier member, and in which case, the second drive means is mounted on the second carrier member.

In another embodiment of the invention the second carrier platform and the second carrier member are moveable simultaneously with the rectilinear motion perpendicular to the first plane.

In one embodiment of the invention a fourth drive means is provided for moving the second carrier member with the rectilinear motion perpendicular to the first plane. Preferably, the fourth drive means is mounted on the base, and in which case, the second

carrier member is carried on the base.

In one embodiment of the invention an intermediate connecting means is carried on the second carrying means for connecting the first and second printed circuit boards with each other when the first and second carrying means are in their respective test positions.

Preferably, the intermediate connecting means is mounted on the second carrier member.

Preferably, the first carrying means comprises a first carrier platform. Advantageously, the first carrier platform is slidably mounted on the base between the loading position and the test position.

In one embodiment of the invention a first locating means is provided on the first carrying means for locating the first printed circuit board on the first carrying means.

In another embodiment of the invention a second locating means is provided on the second carrying means for locating the second printed circuit board on the second carrying means.

In a further embodiment of the invention a first alignment means is provided for aligning the first carrying means with the main carrying means when the first carrying means and the main carrying means are in their respective test positions.

In another embodiment of the invention the second carrying means comprises a second carrier member, the second carrier member being mounted on the main carrying means and being moveable relative thereto with the rectilinear motion in a plane parallel to the first plane.

In another embodiment of the invention the second carrier platform

is releasably and rigidly engageable with the second carrier member.

In a further embodiment of the invention the second carrier platform is connected to the second carrier member by a quick release securing means.

Preferably, the second connecting means comprises a plurality of second electrical connectors for engaging corresponding complementary electrical connectors of the first printed circuit board, the second electrical connectors being resiliently mounted for facilitating alignment of the second electrical connectors with the complementary electrical connectors of the first printed circuit board during engagement thereof.

Preferably, the second connecting means comprises a carrier arm, and the second electrical connectors are resiliently mounted on the carrier arm and are resiliently moveable in the direction of rectilinear movement of the carrier arm. Ideally, the second electrical connectors are resiliently moveable laterally relative to the direction of rectilinear movement of the carrier arm.

The invention will be more clearly understood from the following description of some preferred embodiments thereof which are given by way of example only with reference to the accompanying drawings in which:

Fig. 1 is a perspective view of the test fixture according to the invention illustrated in use in one position,

Fig. 2 is a perspective view of the test fixture of Fig. 1 illustrated in a different position,

Fig. 3 is a typical cross-sectional end elevational view of the test fixture of Fig. 1,

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Fig. 4 is another cross-sectional end elevational view of the test fixture of Fig. 1, the cross-section being taken at a different position as that of Fig. 3,

Fig. 5 is a view similar to Fig. 4 illustrating the test fixture in a different position,

Fig. 6 is a typical cross-sectional front elevational view of the test fixture of Fig. 1,

Fig. 7 is a view similar to Fig. 6 of the test fixture of Fig. 1 in a different position,

Fig. 8 is a view similar to Fig. 6 of the test fixture of Fig. 1 with a portion of the test fixture in a different position,

Fig. 9 is a view similar to Fig. 6 of the test fixture of Fig. 1 with printed circuit boards removed,

Fig. 10 is an underneath plan view of a portion of the test fixture of Fig. 1,

Fig. 11 is a top plan view of another portion of the test fixture of Fig. 1 illustrating portions of the test fixture which are provided on the omitted part of the test fixture illustrated in broken lines,

Fig. 12 is a view similar to Fig. 11 with the parts of the test fixture in broken lines in a different position,

Fig. 13 is an end elevational view of a detail of the test fixture of Fig. 1,

Fig. 14 is a perspective view of the portion of the test fixture of Fig. 13,

Fig. 15 is a perspective view of a detail of the portion of Fig. 13,

Fig. 16 is a perspective view of another portion of the test fixture of Fig. 1,

Fig. 17 is a cross-sectional plan view of a detail of the portion of Fig. 16 of the test fixture of Fig. 1,

Fig. 18 is a cross-sectional end elevational view of another detail of the portion of Fig. 16,

Fig. 19 is a perspective view of a printed circuit board for testing in the test fixture of Fig. 1,

Fig. 20 is a perspective view of another printed circuit board for use in the test fixture of Fig. 1,

Fig. 21 is a perspective view of the test fixture according to another embodiment of the invention, in use,

Fig. 22 is a perspective view of the test fixture of Fig. 21 in a different position to that of Fig. 21,

Fig. 23 is a side elevational view of the test fixture of Fig. 1 illustrated in one position,

Fig. 24 is a view similar to Fig. 23 with the test fixture illustrated in another position,

Fig. 25 is a view similar to Fig. 23 with portions of the test fixture in a different position,

Fig. 26 is a cross-sectional front elevational view of a portion of the test fixture of Fig. 21,

Fig. 27 is a view similar to Fig. 26 with the test fixture in a different position,

Fig. 28 is a view similar to Fig. 26 with a portion of the test fixture in a different position,

Fig. 29 is a perspective view of a detail of the test fixture of Fig. 21,

Fig. 30 is a plan view of a portion of the test fixture of Fig. 21,

Fig. 31 is a plan view of a portion of the test fixture of Fig. 21 with another portion of the test fixture removed,

Fig. 32 is a plan view of a detail of Fig. 31, and

Fig. 33 is a plan view of the detail of Fig. 32 illustrating a portion of the test fixture in a different position to that of Fig. 32.

Referring to the drawings, and initially Figs. 1 to 20 there is illustrated a test fixture according to the invention which is indicated generally by the reference numeral 1 for testing a first printed circuit board, which in this embodiment of the invention is a mother board 2 which is connected to a second printed circuit board, which is a daughter board 3, in this case, a reference daughter board 3.

Before describing the test fixture in detail, the mother and daughter boards 2 and 3, respectively, will first be described briefly with reference to Figs. 19 and 20. The mother board 2 is a typical mother board comprising circuitry and a plurality of components which are not shown. In this embodiment of the invention the mother board 2 is provided with three tab connectors 5 along one side edge 6 of the mother board 2 for receiving the

daughter board 3. A plurality of socket connectors 8 are provided adjacent a side edge 9 of the mother board 2 for receiving cable connectors (not shown) for connecting the mother board 2 to computer peripherals, such as, a printer, a mouse, a visual display unit and the like. A plurality of socket connectors 10 are also provided on the mother board 2 for receiving other daughter boards (not shown). The daughter board 3 comprises a plurality of components (not shown), and three connector sockets 11 for engaging the corresponding three tab connectors 5 of the mother board 2.

The test fixture 1 comprises a support means which comprises a base box 15 and a main carrying means, namely, a main carrier housing 16 which is carried on the base box 15. The base box 15 comprises a base 18 and a top wall 19, which are joined by side and end walls 20 and 21 which together form a hollow interior region 22. The main carrier housing 16 comprises a pair of side walls 23 which are joined by end walls 24, and a sub-base 27 extending between the side and end walls 23 and 24. A first drive means, namely, four first double acting pneumatic rams 29 which are mounted on the top wall 19 and extend into the hollow interior region 22 of the base box 15 connect the main carrier housing 16 to the base box 15, and move the main carrier housing 16 with rectilinear motion downwardly and upwardly in the direction of the arrows A and B, respectively, relative to the base box 15. Piston rods 30 of the first rams 29 extend upwardly through linear bearings (not shown) in the top wall 19, and are secured to angle brackets 31 which are located on the side walls 23 of the main carrier housing 16 for moving the main carrier housing 16 in the directions of the arrows A and B between an inoperative position illustrated in Fig. 2 and a test position illustrated in Fig. 1 as will be described below. Compression springs 32 around the piston rods 30 cooperate between the top wall 19 and collars 33 on the piston rods 30 for urging the main carrier housing 16 away from the base box 15 into the inoperative position.

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A first carrying means for carrying the mother board 2 in a first plane 34, namely, a horizontal plane comprises a first platform 35 which is mounted on the top wall 19 of the base box 15, and is slidable in the direction of the arrows C and D in tracks 36 which are mounted on the top wall 19 between a loading position illustrated in Fig. 2 and a test position illustrated in Fig. 1 for testing the mother board 2 as will be described below. The first platform 35 is slidable in the tracks 36 with rectilinear motion between the loading position and the test position in a plane parallel to the first plane 34 of the mother board 2. A plurality of pads 37 on the first platform 35 receive and support the mother board 2 on the first platform 35. Locating pins 38 extending upwardly from the platform 35 engage locating holes 39 in the mother board 2 for locating and aligning the mother board 2 on the first platform 35.

A second carrying means for carrying the daughter board 3 comprises a second platform 40 which is in turn carried on a second carrier member 41 located in the main carrier housing 16. The second carrier member 41 is mounted in the main carrier housing 16 by a second drive means, namely, a pair of second double acting pneumatic rams 52 which are mounted on the underside of the sub-base 27. Piston rods 42 of the second rams 52 engage mounting bosses 43 on the second carrier member 41 for carrying the second carrier member 41. The second rams 52 move the second carrier member 41 with rectilinear motion in a plane parallel to the first plane 34 of the mother board 2, and in the directions of the arrows E and F between an inoperative position illustrated in Fig. 5 and a test position illustrated in Fig. 4, which is parallel to the direction of motion of the first platform 35. Accordingly, when the first platform 35 with a mother board 2 to be tested mounted thereon is in the test position, and the main carrier housing 16 is moved downwardly in the direction of arrow A into the test position and the second carrier member 41 is moved in the direction of the arrow E into the test position, the connecter sockets 11 of the daughter board 3 engage the tab

connecters 5 of the mother board 2 thereby connecting the daughter board 3 with the mother board 2. An opening 44 in the sub-base 27 accommodates the second carrier member 41 and the second platform 40 and facilitates movement of the second platform 40 and the second carrier member 41 between the inoperative and test positions.

A receiver member 45 extending at the bottom of the second carrier member 41 receives the second platform 40, and an upwardly extending lip 46 engages the daughter board 3 for retaining the daughter board 3 and the second platform 40 in tight engagement with the second carrier member 41. A top member 47 with a downwardly extending lip 48 locates the second platform 40 on the second carrier member 41. A pair of quick release locating pins 49 which are spring loaded in housings 50, which are in turn secured in the second carrier member 41, engage corresponding locating holes 51 in the second platform 40 for locating and securing the second platform 40 in and to the second carrier member 41. A pair of knobs 54 on the top member 47 of the second platform 40 facilitate removal and replacement of the second platform 40 on the second carrier member 41.

A plurality of pads 55 on the second platform 40 receive the daughter board 3, and four locating pins 56 extending from the second platform 40 engage corresponding locating holes 57 in the daughter board 3 for locating and aligning the daughter board 3 on the first platform 40. A transversely extending carrier member 59 extends from and is carried on the second platform 40 and supports a downwardly extending member 60 which in turn carries three spring loaded support pins 61 for engaging free ends of other printed circuit boards (not shown) which may be connected if desired to the daughter board 3.

A plurality of cables (not shown) with corresponding cable connectors (also not shown) are connected to various connectors (not shown) on the daughter board 3 for connecting the daughter

board 3 to test equipment (not shown) for facilitating the writing and reading of signals to the daughter board 3 during testing of the mother board 2. It is not intended to describe the test equipment or the connection of the test equipment to the daughter board 3 in further detail, since such an arrangement will be known to those skilled in the art.

A connecting means for connecting the mother board to the test equipment (not shown) comprises a first connecting means and a second connecting means. The first connecting means comprises three first tab connectors only one of which is illustrated and indicated by the reference numeral 63, which are mounted on and extend downwardly from the sub-base 27 of the main carrier housing 16, see in particular Fig. 3. Cables (not shown) which are connected to the tab connectors 63 connect the tab connectors 63 to the test equipment (not shown) for facilitating writing to and reading from the mother board 2 during testing thereof. The tab connectors 63 are arranged on and located on the sub-base 27 so that when the main carrier housing 16 is moved in the direction of the arrow A into the test position the tab connectors 63 engage the corresponding socket connectors 10 of the mother board 2.

The second connecting means comprise a plurality of second connectors 64 which are carried on a carrier arm 65 which is located in and connected to the main carrier housing 16. A third drive means, namely, a pair of third double acting pneumatic rams 66 are mounted on the under side of the sub-base 27 of the main carrier housing 16, and carry the carrier arm 65. Piston rods 67 extending from the third rams 66 engage the carrier arm 65 for moving the carrier arm 65 with rectilinear motion in a plane parallel to the first plane 34 in the direction of the arrows G and H, between an inoperative position illustrated in Figs. 7 and 8 and a test position illustrated in Fig. 6 for engaging the second connectors 64 with the complementary connectors 8 of the mother board 2. In this embodiment of the invention the movement of the carrier arm 65 in the direction of the arrows G and H is

perpendicular to the direction of movement of the first platform 35.

Cables (not shown) extend from cable connectors 68 on the carrier arm 65 for connecting the second connectors 64 and in turn the mother board 2 to the test equipment (not shown) during testing.

In this embodiment of the invention the second connectors 64 include second connectors 64*a* which are pin connectors, second connectors 64*b* which are coaxial pin connectors, and a tab connector 64*c*. All the second connectors 64 are resiliently mounted on the carrier arm 65 for facilitating alignment of the pins and tabs of the second connectors 64 with the corresponding complementary connectors 8 of the mother board 2 as the carrier arm 65, and in turn the second connectors 64 are being urged in the direction of the arrow G into the test position.

Referring in particular to Fig. 17 the resilient mounting of the second pin connectors 64*a* is achieved as follows. Each pin connector 64*a* is secured to the carrier arm 65 by a pair of screws 69 which engage corresponding clearance holes 70 in a housing 88 of the pin connectors 64*a*. The screws 69 are tightened so that limited longitudinal movement of the housing 88 in the direction of arrows J and K along the screws 69 is permitted between the carrier arm 65 and heads 71 of the screws 69. A pair of compression springs 72 around the screws 69 and located in bores 73 of the housing 88 act between shoulders 74 of the bores 73 and the carrier arm 65 for urging the housing 88 of the second connectors 64*a* against the heads 71 of the screws 69. The heads 71 of the screws 69 are tapered at 62 for engaging corresponding tapers 89 in the bores 70 for centering he housing 88 on the screws 69. Accordingly, as the carrier arm 65 is moved in the direction of the arrow G towards the test position for engaging the second connectors 64 with the complementary connectors 8 of the mother board 2, longitudinal movement along the screws 69 in the direction of the arrow K, and also lateral movement relative

to the screws 69 of the housing 88 of the second connectors 64*a* is permitted for facilitating alignment of the pins of the second connectors 64*a* with the corresponding connectors 8 of the mother board 2.

Referring now to Fig. 18 the coaxial pin connectors 64*b* are resiliently mounted on the carrier arm 65 as follows. Each connector 64*b* is provided with a housing 75 having a tapered step 78 which engages a clearance bore 76 in a mounting block 77, which is secured by screws 87 to the carrier arm 65. A correspondingly tapered shoulder 82 in the bore 76 engages the tapered step 78 of the housing 75 for centering the housing 75 in the bore 76. A compression spring 80 is located in a cavity 81 formed in the mounting block 77 and the carrier arm 65, and acts between the carrier arm 65 and the housing 75 for resiliently urging the tapered step 78 of the coaxial pin connector 64*b* into the tapered shoulder 82 of the bore 76 of the mounting block 77. Accordingly, movement in the direction of the arrows L and M of the second connector 64*b* relative to the carrier arm 65 is accommodated. By virtue of the fact that the bore 76 is a clearance bore lateral movement of the second connector 64*b* relative to the carrier arm 65, is also accommodated for facilitating alignment and engagement of the second connectors 64*b* with the corresponding complementary connectors 8 of the mother board 2 as the carrier arm 65 is being moved in the direction of the arrow G into the test position. A bore 79 through the carrier arm 65 into the cavity 81 accommodates a cable to the corresponding second connector 64*b* for connecting the second connectors 64*b* to the test equipment (not shown).

The tab connector 64*c* is located in a guide slot 83 of a mounting block 84 which is in turn secured to the carrier arm 65. The guide slot 83 is sized to provide limited lateral movement of the tab connector 64*c* during engagement of the tab connector 64*c* with the corresponding complementary connector 8 on the mother board 2. Limited inward and outward movement of the tab connector 64*c* through the guide slot 83 is also accommodated for facilitating

alignment and engagement of the tab connector 64*c* with its corresponding complementary socket 8 on the mother board 2.

Alignment means provided by a pair of alignment pins 85 extend downwardly from the sub-base 27 of the main housing 16 for aligning the first platform 35 with the main carrier housing 16 when the main platform 35 is in the test position and the main carrier housing 16 is being moved downwardly by the first rams 29 in the direction of the arrow A into the test position. The alignment pins 85 engage corresponding alignment holes 86 in the first platform 35 as the main carrier housing 16 is being moved in the direction of the arrow A downwardly into the test position.

Pneumatic and electrical control circuitry (not shown) is provided for controlling the operation of the first, second and third rams 29, 52 and 66, respectively, so that the rams operate in the following sequence during a test procedure of a mother board 2. Initially, the first, second and third rams 29, 52 and 66 are in a condition with the main carrier housing 16, the second carrier member 41 and the carrier arm 65 all in the inoperative positions. When the mother board 2 has been placed on the first platform 35, and the first platform 35 has been manually moved in the direction of the arrow C into the test position, the four first rams 29 are simultaneously operated to retract the piston rods 30 for urging the main carrier housing 16 into the test position. On the main carrier housing 16 being in the test position, the second and third rams 52 and 66 are then operated simultaneously to extend their respective piston rods 42 and 67 for urging the second carrier member 41 and the carrier arm 65 into their respective test positions. When the first platform is in the test position and the main carrier housing 16, the second carrier member 41 and the carrier arm 65 are all in their test positions, the mother board 2 and the daughter board 3 are connected with each other, and the mother board 2 is connected to the test equipment, and the test can proceed.

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In use, to test a mother board 2, the test fixture 1 is set up with the daughter board 3 mounted on the second platform 40 which is secured to the second carrier member 41. All relevant connections from the daughter board 3, the first tab connectors 63 and the second connectors 64 are connected to the test equipment. The first, second and third rams 29, 52 and 66, respectively, are operated to move the main carrier housing 16, the second carrier member 41 and the carrier arm 65 into their respective inoperative positions. The mother board 2 to be tested is placed on the first platform 35 in the loading position, and the locating pins 38 are engaged with the corresponding holes 39 in the mother board 2. The first platform 35 is manually moved in the direction of the arrow C from the loading position into the test position and the control circuit is operated for operating the first, second and third rams 29, 52 and 66 in sequence for initially urging the carrier housing 16 in the direction of the arrow A into the test position so that the first tab connectors 63 engage the corresponding connectors 10 of the mother board 2, and then for simultaneously urging the second carrier member 41 and the carrier arm 65 into their respective test positions so that the connector socket 11 of the daughter board 3 engages the tab connectors 5 of the mother board 2, and the second connectors 64 engages the corresponding complementary connectors 8 of the mother board 2. Accordingly, all connections have been made to the mother board 2, and the daughter board 3 is also connected to the mother board 2. The test equipment is then activated for testing the mother board 2. When the test has been completed the first, second and third rams 29, 52 and 66 are operated in the reverse order for initially disengaging the daughter board 3 from the mother board 2 and the second connectors 64 from the connectors 8 of the mother board 2, by moving the second carrier member 41 in the direction of the arrow F, and the carrier arm 65 in the direction of the arrow H into their respective inoperative positions. The main carrier housing 16 is then moved in the direction of the arrow B into the inoperative position for disengaging the first connectors 63 from the mother board 2. The first platform 35 is manually moved from

the test position to the loading position and the tested mother board 2 is removed and replaced by the next mother board 2 to be tested.

Should it be desired to replace the daughter board 3, the second platform 40 is removed from the second carrier member 41 by disengaging the locating pins 49 from the locating holes 51 in the second platform 40 and lifting the second platform 40 from the second carrier member 41. With the second carrier member 40 removed, the daughter board 3 can be replaced with another daughter board 3.

Referring now to Figs. 21 to 33 there is illustrated a test fixture 90 according to another embodiment of the invention. The test fixture 90 is somewhat similar to the test fixture 1, and relatively similar components are identified by the same reference numerals. In this embodiment of the invention the test fixture 90 is suitable for testing a first printed circuit board, which in this case is also a mother board 2 with a second printed circuit board, namely, a daughter board 3 which is a reference board connected to the mother board 2 under test. The mother and daughter boards 2 and 3, respectively, which may be tested on the test fixture 90 are different to those which may be tested on the test fixture 1, in particular, a tab connector 92 is provided on one side edge of the daughter board 3 which is engageable with a socket connector 93 of the mother board 2. In normal operation the tab connector 92 engages the socket connector 93 with the daughter board 3 extending perpendicularly from the mother board 2. Socket connectors 10 are also provided on the mother board 2 but these are of different type, and in different locations to those of the mother board 2, for which the test fixture 1 is suitable. Some of the socket connectors 10 of the mother board 2 which may be tested on the test fixture 90 are for receiving tab connectors, of for example, other printed circuit boards, and others of the socket connectors 10 are for receiving pin connectors, which may be on other printed circuit boards, or may

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terminate cables.

The test fixture 90 comprises a base box 15 which is substantially similar to the base box 15, and a main carrier housing 16, which is substantially similar to the main carrier housing 16 of the test fixture 1. The main carrier housing 16 is moveable by first rams 29 which are identical to the first rams 29 of the test fixture 1 in the direction of the arrows A and B between the inoperative and test positions.

First connectors 63 which in this case comprise a combination of a tab connectors 63*a* and pin connectors 63*b* are mounted on and extend downwardly from the sub-base 27 of the main carrier housing 16 for engaging the socket connectors 10 of the mother board 2 when the main carrier housing 16 is in the test position. The tab connectors 63*a*, one of which is clearly illustrated in Figs. 26 to 28 is resiliently mounted on the sub-base 27. The tab connector 63*a* comprises a printed circuit board 105 which extends through a slot 106 in the sub-base 27. The printed circuit board 105 is carried on a support bar 107 within the main carrier housing 16 on a pair of carrier screws 108 extending upwardly from the sub-base 27. The support bar 107 is slidable along the carrier screws 108, and compression springs 109 acting between the support bar 107 and heads 110 urge the support bar 107 and the tab connector 63*a* downwardly through the slot 106. A socket 111 on the printed circuit board 105 is provided for connecting the tab connector 63*a* to the test equipment (not shown). Electrical contacts 112 at the lower end 114 of the tab connector 63*a* are provided for engaging corresponding contacts (not shown) in the corresponding socket connector 10 of the printed circuit board 2. Electrically conductive tracks 115 connect the electrical connectors 112 with the socket 111. The carrier screws 108 slidably engage clearance bores (not shown) in the support bar 107 for accommodating lateral movement of the tab connector 63*a* relative to the direction of movement in the directions of the arrows A and B of the main carrier housing 16, so that when the main carrier housing 16 is

being moved in the direction of the arrow A into the test position alignment of the tab connectors 63*a* with the corresponding socket connectors 10 of the mother board 2 is facilitated. The slots 106 through the sub-base 27 through which the printed circuit boards 105 of the tab connectors 63*a* extends also accommodate this lateral movement. The compression springs 109 accommodate resilient upward movement of the tab connectors 63*a* on engagement with the socket connectors 10 of the mother board 2 to avoid damage to either the tab connectors 63*a* or the socket connectors 10.

The main difference between the test fixture 90 and the test fixture 1 is in the second carrying means for carrying the daughter board 3, and in the location of the carrier arm 65. In this embodiment of the invention for ease of testing the mother board 2, the daughter board 3 is carried on a second platform 94 of the second carrying means in a plane parallel to the first plane 34 of the mother board 2. The second platform 94 is carried on a second carrier member 95 which is in turn carried on the base box 15, as will be described below. An intermediate connector member 96 is carried on the second carrier member 95 by a pair of brackets 91, and is provided by a printed circuit board which terminates in a tab connector 97 for engaging the socket connector 93 of the mother board 2. A socket connector 98 is carried on the intermediate connector member 96, and is located relative to the second platform 94 for engaging the tab connector 92 of the daughter board 3 when the second platform 94 is in the test position. Electrically conductive tracks (not shown) on the printed circuit board of the intermediate connector member 96, connect the socket connector 98 with the tab connector 97.

In this embodiment of the invention a pair of second rams 100 for moving the second platform 94 in the direction of the arrows E and F between the inoperative position see Fig. 26, and the test position see Fig. 27, are mounted on the second carrier member 95. The second rams 100 move the second platform 94 with rectilinear

motion in a plane parallel to the first plane 34 in a direction transversely of the direction of motion of the first platform 35. The second rams 100 move the second platform 94 between the inoperative position and the test position for engaging the tab connector 92 of the daughter board 3 with the socket connector 98 of the intermediate connector member 96. Piston rods 101 extend from the second rams 100 and carry a mounting bar 104 to which the platform 94 is secured.

The second carrier member 95 is connected to the base box 15 by a fourth drive means, namely, a pair of fourth double acting pneumatic rams 102, which are mounted on the top wall 19 and are located in the hollow interior region 22 of the base box 15. The fourth rams 102 move the second carrier member 95, and in turn the second platform 92 with rectilinear motion in the direction of the arrows P and Q perpendicularly to the first plane 34, between an inoperative position illustrated in Fig. 26 and a test position illustrated in Fig. 27 with the tab connector 97 of the intermediate connector member 96 engaged in the socket connector 93 of the mother board 2. Piston rods 103 extend from the fourth rams 102 and are secured to the second carrier member 95.

In this embodiment of the invention instead of being mounted on the sub-base 27 of the main carrier housing 16, the carrier arm 65 is mounted on the top wall 19 of the base box 15. The third rams 66 are also mounted on the top wall 19 of the base box 15, and move the carrier arm 65, and in turn the second connector 64 with rectilinear motion in the direction of the arrows G and H for engaging the second connectors 64 with the corresponding complementary connectors 8 of the mother board 2. The direction of motion of the carrier arm 65 between the inoperative and test positions is parallel to the direction of motion of the first platform 35.

Otherwise the test fixture 90 is similar to the test fixture 1.

In use, a reference daughter board 3 is placed on the second platform 94, or alternatively a daughter board 3 matched with the mother board 2 may be mounted on the second platform 94. Where the daughter board 3 is a reference daughter board, in general, the same reference daughter board will be used to test many mother boards 2. However, on the other hand, where it is desired to test matched mother and daughter boards 2 and 3, the daughter boards are replaced for each test. The relevant connections from the daughter board 3 and the relevant connections from the first and second connectors 63 and 64 are made to the test equipment.

The main carrier housing 16, the second carrier member 95 and the second platform 94 as well as the carrier arm 65 are all moved by their respective rams into their inoperative positions. The first platform 35 is manually moved to the loading position, and the mother board 2 to be tested is place on the first platform 35 as already described. The first platform 35 is manually moved into the test position. If the daughter board 3 is to be a matched daughter board with the mother board 2, the matched daughter board 3 is placed on the second platform 94. Otherwise, the reference daughter board 3 is placed on the second platform 94, if the reference daughter board 3 is not already on the second platform 94. The control circuitry (not shown) is operated to operate the first, second, third and fourth rams 29, 52, 66 and 102 in sequence for initially moving the main carrier housing 16 in the direction of the arrow A into the test position so that the first connectors 63 engages the corresponding complementary connector sockets 10 of the mother board 2. The second platform 94 is then moved by the second rams 52 from the inoperative position to the test position for engaging the tab connector 92 of the daughter board 3 with the socket connector 98 of the intermediate connector member 96. The fourth rams 102 are then operated for urging the second carrier member 95 in the direction of the arrow P from the inoperative position to the test position for engaging the tab connector 97 of the intermediate connector member 96 with the socket connector 93 of the mother board 2. The third rams 66 are

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operated for urging the carrier arm 65 in the direction of the arrow G from the inoperative position to the test position for engaging the second connectors 64 with the corresponding complementary connectors 8 of the mother board 2.

At this stage, all connections to the mother board 2 are made and the test equipment is operated for testing the mother board 2 and if the daughter board 3 is a matched daughter board for also testing the daughter board 3. When the test is completed the control circuit operates the first, second, third and fourth rams in the reverse sequence for initially moving the carrier arm 65 from the test to the inoperative position, then for moving the second carrier member 95 from the test to the inoperative position, and then for moving the second platform 94 from the test to the inoperative position, and lastly, the first rams are operated for moving the main carrier housing 16 from the test to the inoperative position. The first platform 35 is manually moved from the test to the loading position and the tested mother board 2 is removed and replaced with the next mother board 2 to be tested. If the mother board and daughter board are to be tested as matched pairs, the daughter board 3 is also removed from the second platform 94 and replaced with the next daughter board to be tested with its matched mother board.

In the event that the daughter board 3 is a reference daughter board, and is not to be changed between the test of the respective mother boards, it will be appreciated that the second platform 94 may remain in the test position, and it will only be necessary to operate the fourth rams 102 for urging the second carrier member 95 between the inoperative and test positions for engaging and disengaging the intermediate connectors 96 with the mother board 2.

The advantages of the test fixtures according to the invention are many. In particular, the test fixtures permit a printed circuit board, for example, a mother board or indeed, a daughter board to

be readily easily and rapidly tested. By merely placing the printed circuit board to be tested on the first platform and manually moving the first platform from the loading position to the test position, and then operating the control circuitry (not shown) the test fixtures according to the invention operate to connect the printed circuit board under test, for example, a mother board with a daughter board, and also for connecting various connectors of the printed circuit board under test to test equipment. Once the printed circuit board under test has been connected to the daughter board and the test equipment, testing of the printed circuit board can readily easily be carried out. Where it is desired that the test fixtures be used for testing a range of different printed circuit boards, by replacing the first connectors on the sub-base of the main carrier housing and the second connectors on the carrier arm with appropriate connectors, and if necessary repositioning the connectors, the test fixtures can readily easily be adapted for testing printed circuit boards of different types. Another advantage of the invention is that it permits printed circuit boards to be tested in matched pairs or connected to another reference printed circuit board. A further advantage of the invention is that the appropriate connections are made to the printed circuit board under test with the minimum danger of damage to connectors of the printed circuit board.

It will be appreciated that while specific first and second connectors have been described, it will be readily apparent to those skilled in the art that the first and second connectors will be appropriate for matching and engaging the connectors of the printed circuit boards to be tested. Additionally, it will be appreciated that the arrangement of the first and second connectors will also be appropriate to the printed circuit boards being tested. Needless to say, the first and second printed circuit boards may be engageable by different means on the respective carrier means than those already described, and the test fixture may be appropriately adapted to ensure proper connection of the two printed circuit boards. This, will be

readily apparent to those skilled in the art.

It will be appreciated that as well as the test fixtures according to the invention being suitable for testing a mother board, namely, the first printed circuit board 2, the test fixtures may also be used for testing a daughter board, namely, the second printed circuit board 3. In which case, it is envisaged that a reference mother board, in other words, a mother board already tested with known characteristics would be located on the first platform for the duration of the tests of the daughter boards. In the case of the test fixture 90 the daughter boards to be tested would be sequentially placed on the second carrier platform 94, and the second pneumatic rams 52 would be operated for engaging each daughter board with the intermediate connector member 96. In the case of the test fixture 1 daughter boards would be sequentially placed on the second platform 40 which would be removed each time a test was completed to receive the next daughter board. In the case of both test fixtures 1 and 90 the mother board would be placed and secured on the first platform 35 and connected to the test equipment for the duration of the tests. In the case of the test fixture 1 the main carrier housing 16 would be retained in the test position by the first rams 29, so that when the cartridge second platform 40 is engaged on the second carrier member 41 the sockets 11 of the daughter board 3 to be tested would be aligned with the tab connectors 5 of the mother board 2. Similarly, the third rams 66 would be operated to retain the second connectors 64 in continuous engagement with the corresponding connectors 8 of the mother board. In this way, the testing of daughter boards in the test fixture 1 would only require operation of the second rams 52. For testing such daughter boards in the test fixture 90 the main carrier housing 16 would be retained in the test position for the duration of the test, as would the carrier arm with the second connectors, and the second carrier member 95. The second platform 94 would then be operated by the second rams 52 between the inoperative and test positions.

CLAIMS

1. A test fixture (1,90) for testing one of a first printed circuit board (2) and a second printed circuit board (3), with the other of the first and second printed circuit boards (2,3) being connected to the printed circuit board (2,3) under test, characterised in that the test fixture (1,90) comprises

a support means (15,16),

a first carrying means (35) supported on the support means (15,16) for carrying the first printed circuit board (2) with the first printed circuit board (2) lying in a first plane (34),

a second carrying means (40,94) supported on the support means (15,16) for carrying the second printed circuit board (3) with the second printed circuit board (3) lying in a second plane,

at least one of the first and second carrying means (35,40,94) being moveable relative to the other for releasably electrically connecting the first and second printed circuit boards (2,3) with each other, and

a connecting means (63,64) supported on the support means (15,16) for releasably electrically connecting the printed circuit board (2,3) of the first and second printed circuit boards (2,3) under test to test equipment,

at least one of the connecting means (63,63) and the carrying means (35,40,94) of the first and second carrying means (35,40,94) for carrying the printed circuit board (23) under test being moveable relative to the other for releasably electrically connecting the connecting means (63,64) with the printed circuit board (2,3) under test.

2. A test fixture as claimed in Claim 1 characterised in that the first carrying means (35) is moveable with rectilinear motion in a plane parallel to the first plane (34) between a loading position for facilitating loading of the first printed circuit board (2) onto the first carrying means (35) and a test position in which the first printed circuit board (2) is tested.

3. A test fixture as claimed in Claim 1 or 2 characterised in

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that the support means (15,16) comprises a base (19) and a main carrying means (16), the first carrying means (35) being carried on the base (19).

4. A test fixture as claimed in Claim 3 characterised in that the main carrying means (16) is moveably mounted on the base (19) and is moveable with rectilinear motion relative to the base (19) in a plane perpendicular to the first plane (34) between an inoperative position and a test position.

5. A test fixture as claimed in any of Claims 2 to 4 characterised in that the second carrying means (40,94) is moveable with rectilinear motion in a plane parallel to the first plane (34) between an inoperative position and a test position so that when the first and second carrying means (35,40,94) are in their respective test positions, the first and second printed circuit boards (2,3) are electrically connected.

6. A test fixture as claimed in any of Claims 2 to 5 characterised in that the second carrying means (40,94) is moveable with rectilinear motion in a plane perpendicular to the first plane (34) between an inoperative position and a test position.

7. A test fixture as claimed in any preceding claim characterised in that the first carrying means (35) is disposed relative to the second carrying means (40) so that the respective first and second planes are at an angle to each other.

8. A test fixture as claimed in any preceding claim characterised in that the first carrying means (35) is disposed relative to the second carrying means (40) so that the respective first and second planes are perpendicular to each other.

9. A test fixture as claimed in any of Claims 2 to 8 characterised in that the direction of motion of the second

carrying means (40,94) is parallel to the direction of motion of the first carrying means (35).

10. A test fixture as claimed in any of Claims 2 to 9 characterised in that the direction of motion of the second carrying means (40,94) is perpendicular to the direction of motion of the first carrying means (35).

11. A test fixture as claimed in any of Claims 3 to 10 characterised in that a first drive means (29) is provided for moving the main carrying means (16) relative to the base (19).

12. A test fixture as claimed in any of Claims 2 to 11 characterised in that a second drive means (52,100) is provided for moving the second carrying means (40,94) with the rectilinear motion parallel to the first plane (34).

13. A test fixture as claimed in any of Claims 2 to 12 characterised in that the second carrying means (40) is mounted on the main carrying means (16) and is moveable with the main carrying means (16) with the rectilinear motion perpendicular to the first plane (34).

14. A test fixture as claimed in Claim 12 or 13 characterised in that the second drive means (52) is mounted on the main carrying means (16).

15. A test fixture as claimed in any of Claims 2 to 14 characterised in that the connecting means (63,64) comprises a first connecting means (63), the first connecting means being moveable with rectilinear motion in a plane perpendicular to the first plane (34) between an inoperative position and a test position for electrically engaging the first printed circuit board (2).

16. A test fixture as claimed in Claim 15 characterised in that

the first connecting means (63) is mounted on the main carrying means (16) and is moveable with the main carrying means (16) between the inoperative position and the test position.

17. A test fixture as claimed in Claim 15 or 16 characterised in that the connecting means (63,64) comprises a second connecting means (64), the second connecting means (64) being moveable relative to the first carrying means (35) with rectilinear motion in a plane parallel to the first plane (34) between an inoperative position and a test position for electrically engaging the first printed circuit board (2).

18. A test fixture as claimed in Claim 17 characterised in that the direction of motion of the second connecting means (64) is perpendicular to the direction of motion of the first carrying means(35).

19. A test fixture as claimed in Claim 17 characterised in that the direction of motion of the second connecting means (64) is parallel to the direction of motion of the first carrying means (35).

20. A test fixture as claimed in any of Claims 17 to 19 characterised in that the second connecting means (64) is mounted on the main carrying means (16) and is moveable between the inoperative position and the test position relative to the main carrying means (16).

21. A test fixture as claimed in any of Claims 17 to 19 characterised in that the second connecting means (64) is mounted on the base (19) and is moveable between the inoperative position and the test position relative to the base (19).

22. A test fixture as claimed in any of Claims 17 to 21 characterised in that a third drive means (66) is provided for moving the second connecting means (64) between the inoperative

position and the test position.

23. A test fixture as claimed in Claim 22 characterised in that the third drive means (66) is mounted on the base (19).

24. A test fixture as claimed in Claim 22 characterised in that the third drive means (66) is mounted on the main carrying means (16).

25. A test fixture as claimed in any of Claims 2 to 24 characterised in that the second carrying means (40,94) comprises a second carrier platform (40,94) for receiving the second printed circuit board (3).

26. A test fixture as claimed in Claim 25 characterised in that the second carrying means (40,94) comprises a second carrier member (41,95) for carrying the second carrier platform (40,95), the second carrier platform (94) being moveable relative to the second carrier member (95) with the rectilinear motion parallel to the first plane (34).

27. A test fixture as claimed in Claim 26 characterised in that the second drive means (100) moves the second carrier platform (94) relative to the second carrier member (95).

28. A test fixture as claimed in Claim 26 or 27 characterised in that the second drive means (100) is mounted on the second carrier member (94).

29. A test fixture as claimed in any of Claims 26 to 28 characterised in that the second carrier platform (94) and the second carrier member (95) are moveable simultaneously with the rectilinear motion perpendicular to the first plane (34).

30. A test fixture as claimed in any of Claims 26 to 29 characterised in that a fourth drive means (102) is provided for

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moving the second carrier member (95) with the rectilinear motion perpendicular to the first plane (34).

31. A test fixture as claimed in Claim 30 characterised in that the fourth drive means (102) is mounted on the base (19).

32. A test fixture as claimed in any of Claims 26 to 31 characterised in that the second carrier member (95) is carried on the base (19).

33. A test fixture as claimed in any of Claims 26 to 32 characterised in that an intermediate connecting means (96) is carried on the second carrying means (95) for connecting the first and second printed circuit boards (2,3) with each other when the first and second carrying means (35,94) are in their respective test positions.

34. A test fixture as claimed in Claim 33 characterised in that the intermediate connecting means (96) is mounted on the second carrier member (95).

35. A test fixture as claimed in any preceding claim characterised in that the first carrying means (35) comprises a first carrier platform (35).

36. A test fixture as claimed in Claim 35 characterised in that the first carrier platform (35) is slidably mounted on the base (19) between the loading position and the test position.

37. A test fixture as claimed in any preceding claim characterised in that a first locating means (38) is provided on the first carrying means (35) for locating the first printed circuit board (2) on the first carrying means (35).

38. A test fixture as claimed in any preceding claim characterised in that a second locating means (56) is provided on

the second carrying means (40,94) for locating the second printed circuit board (2) on the second carrying means (40,94).

39. A test fixture as claimed in any of Claims 3 to 38 characterised in that a first alignment means (85) is provided for aligning the first carrying means (35) with the main carrying means (16) when the first carrying means (35) and the main carrying means (16) are in their respective test positions.

40. A test fixture as claimed in any of Claims 3 to 39 characterised in that the second carrying means (40) comprises a second carrier member (41), the second carrier member (41) being mounted on the main carrying means (16) and being moveable relative thereto with the rectilinear motion in a plane parallel to the first plane (34).

41. A test fixture as claimed in Claim 40 characterised in that the second carrier platform (40) is releasably and rigidly engageable with the second carrier member (41).

42. A test fixture as claimed in Claim 41 characterised in that the second carrier platform (40) is connected to the second carrier member (41) by a quick release securing means (49).

43. A test fixture as claimed in any of Claims 27 to 42 characterised in that the second connecting means (64) comprises a plurality of second electrical connectors (64) for engaging corresponding complementary electrical connectors (8) of the first printed circuit board (2), the second electrical connectors (64) being resiliently mounted for facilitating alignment of the second electrical connectors (64) with the complementary electrical connectors (8) of the first printed circuit board (2) during engagement thereof.

44. A test fixture as claimed in Claim 43 characterised in that the second connecting means (64) comprises a carrier arm (65), and

the second electrical connectors (64) are resiliently mounted on the carrier arm (65) and are resiliently moveable in the direction of rectilinear movement of the carrier arm (65).

45. A test fixture as claimed in Claim 43 or 44 characterised in that the second electrical connectors (64) are resiliently moveable laterally relative to the direction of rectilinear movement of the carrier arm (64).

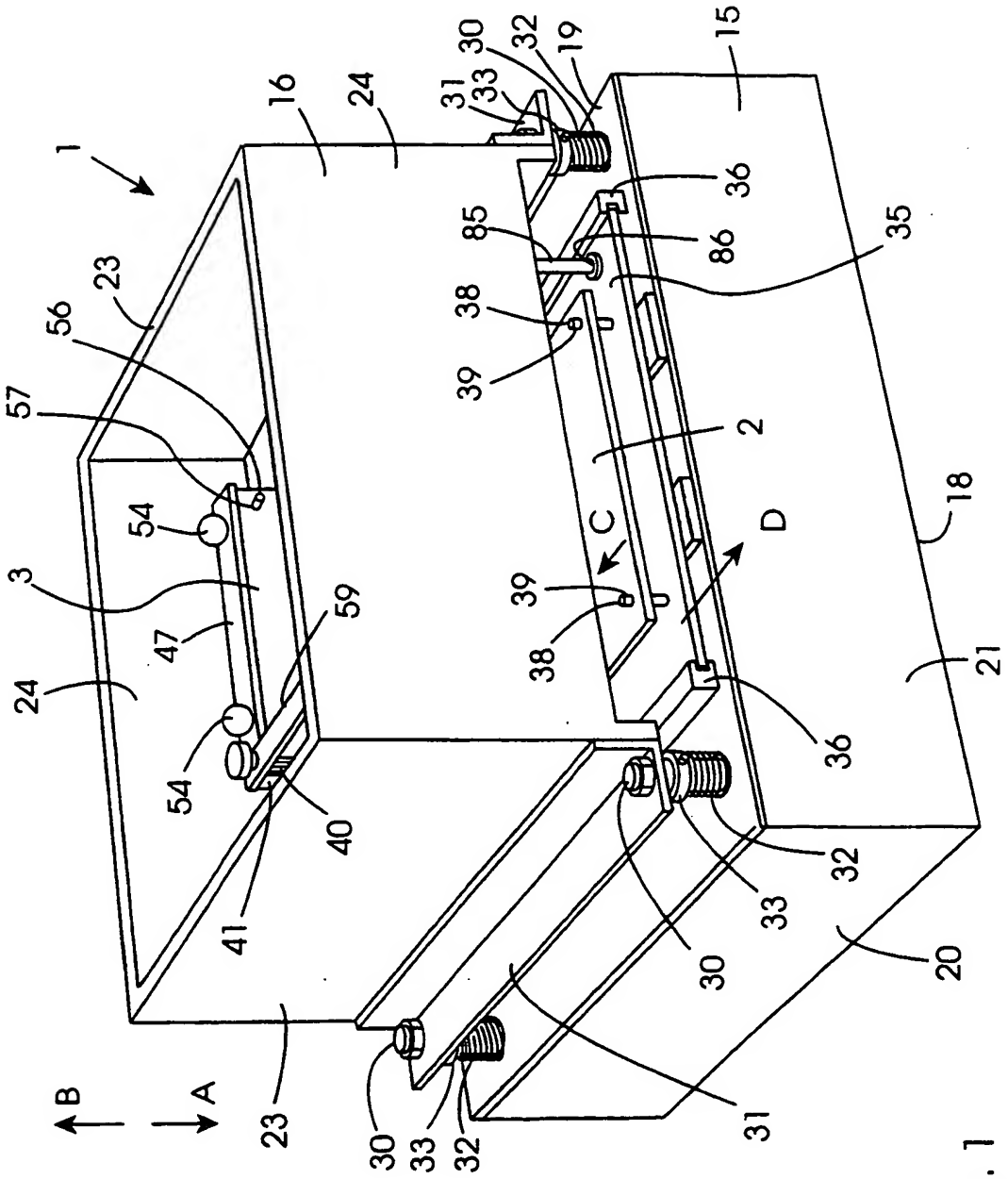
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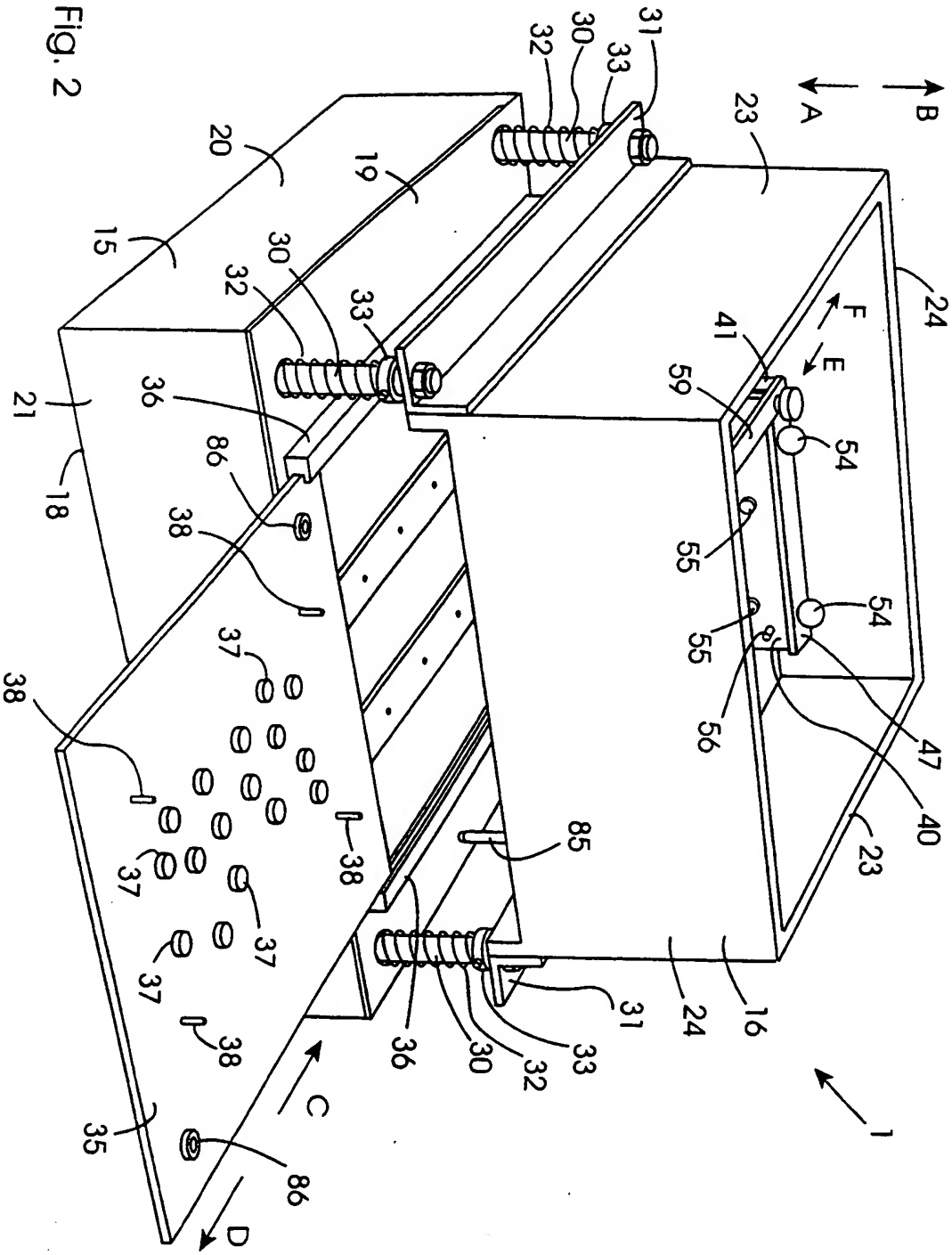
Fig. 1

Fig. 2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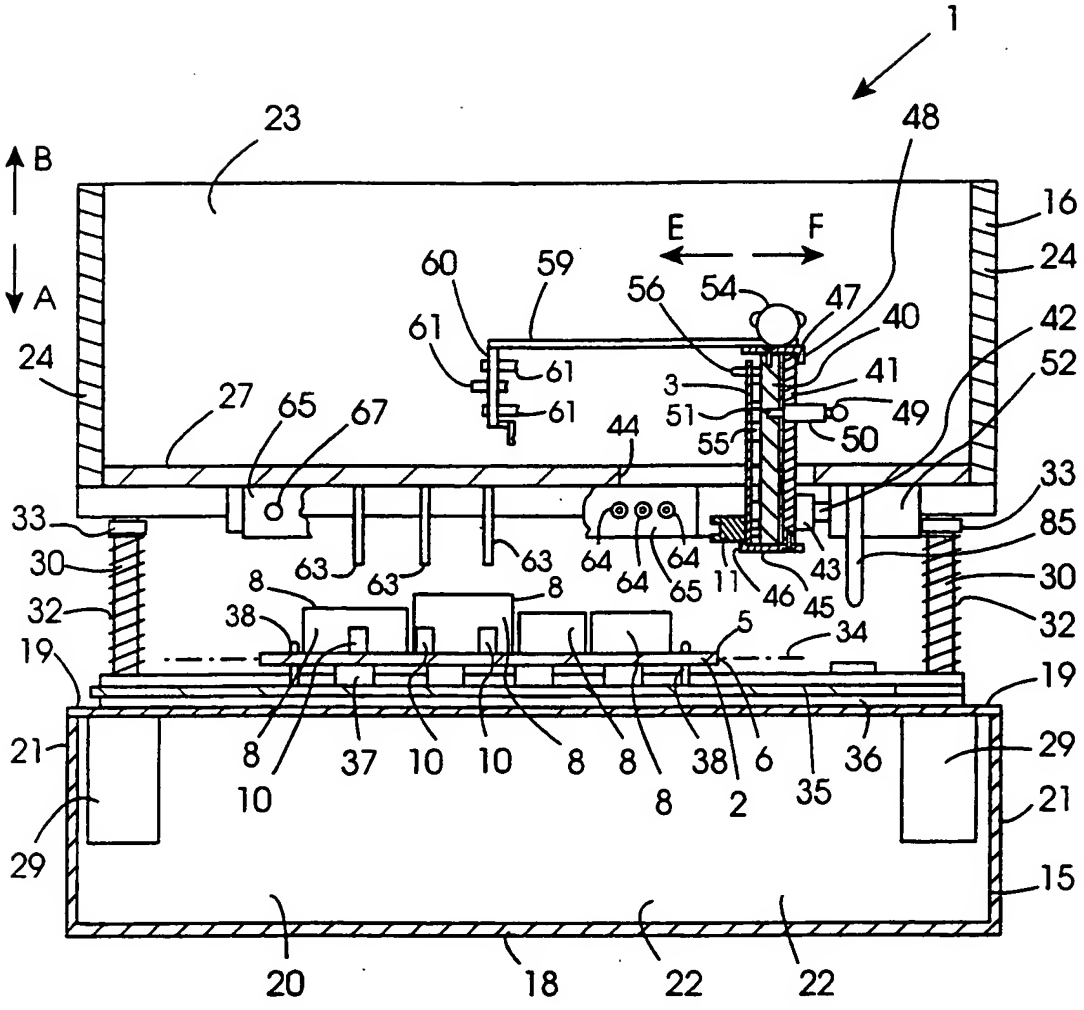
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Fig. 3

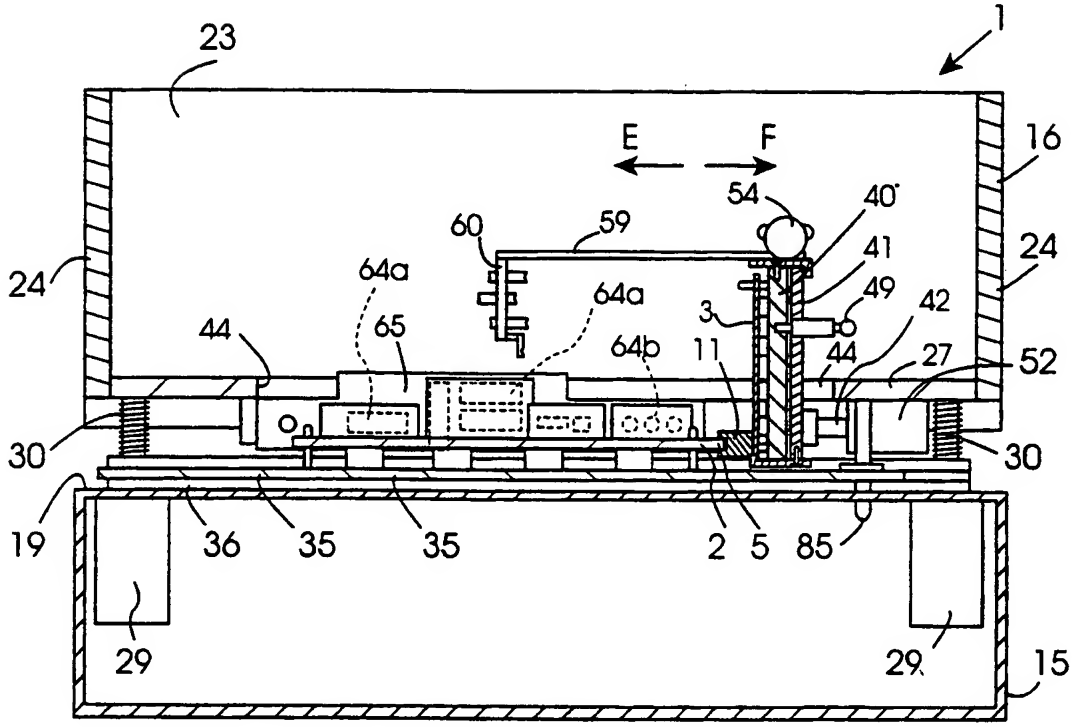
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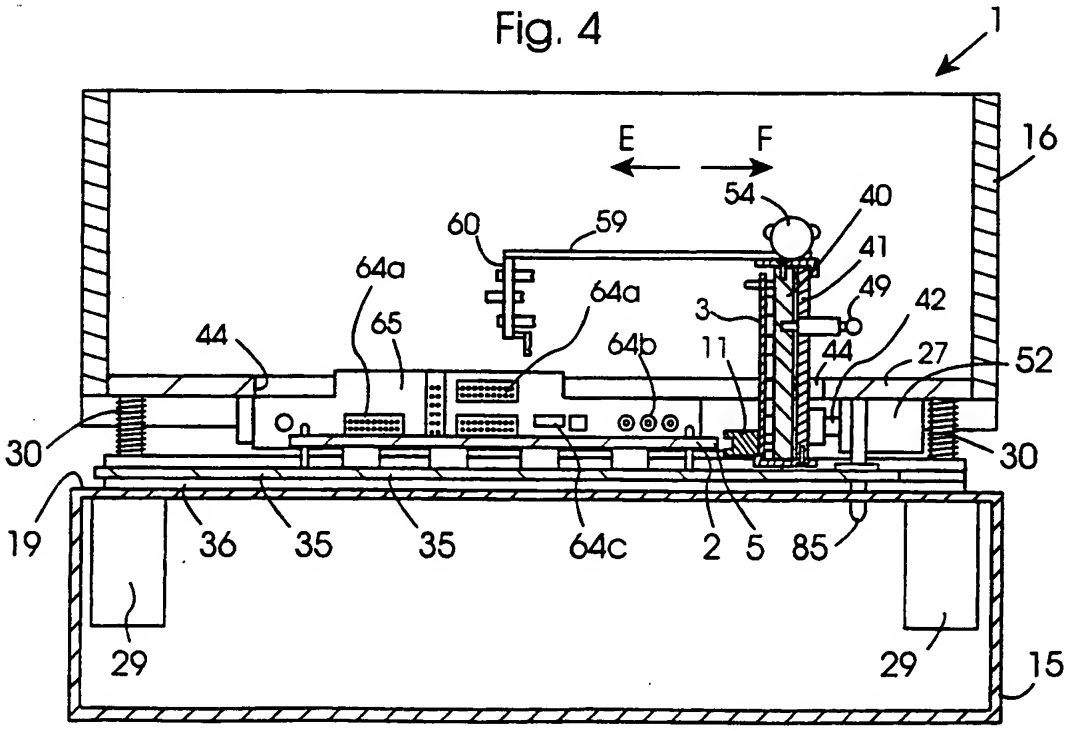
Fig. 4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35
64c
2
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85
29
29
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Fig. 5

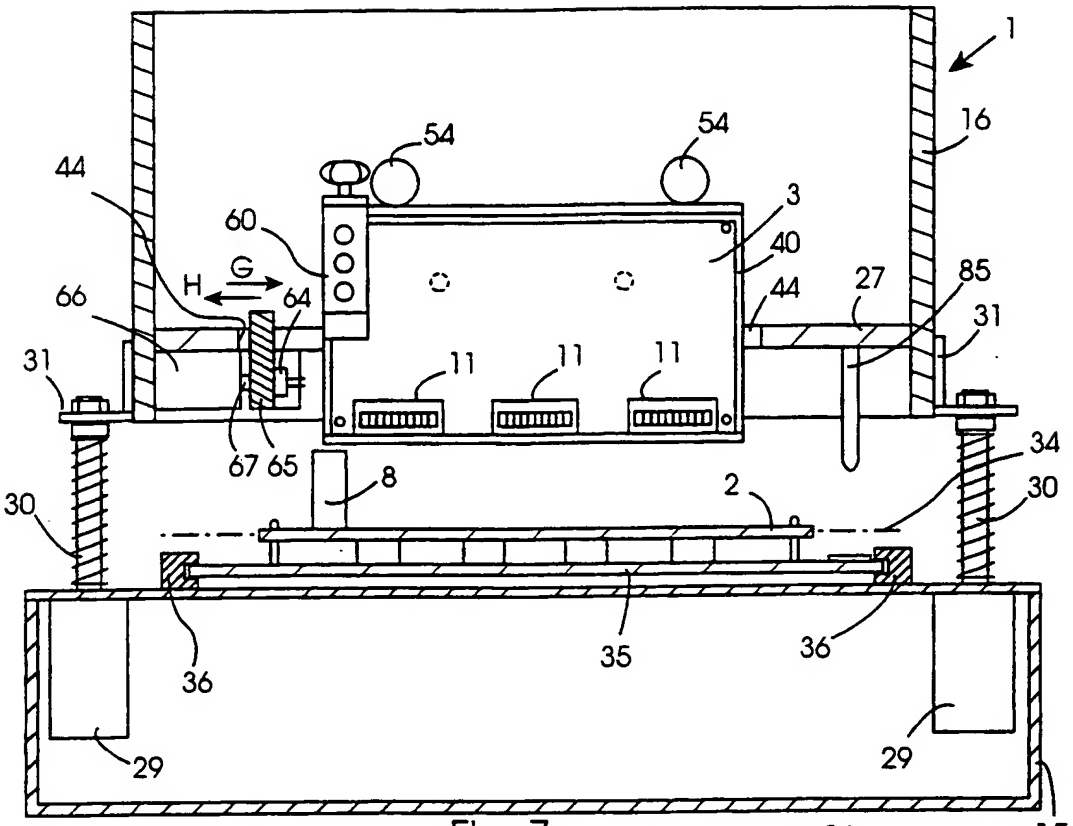
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Fig. 7

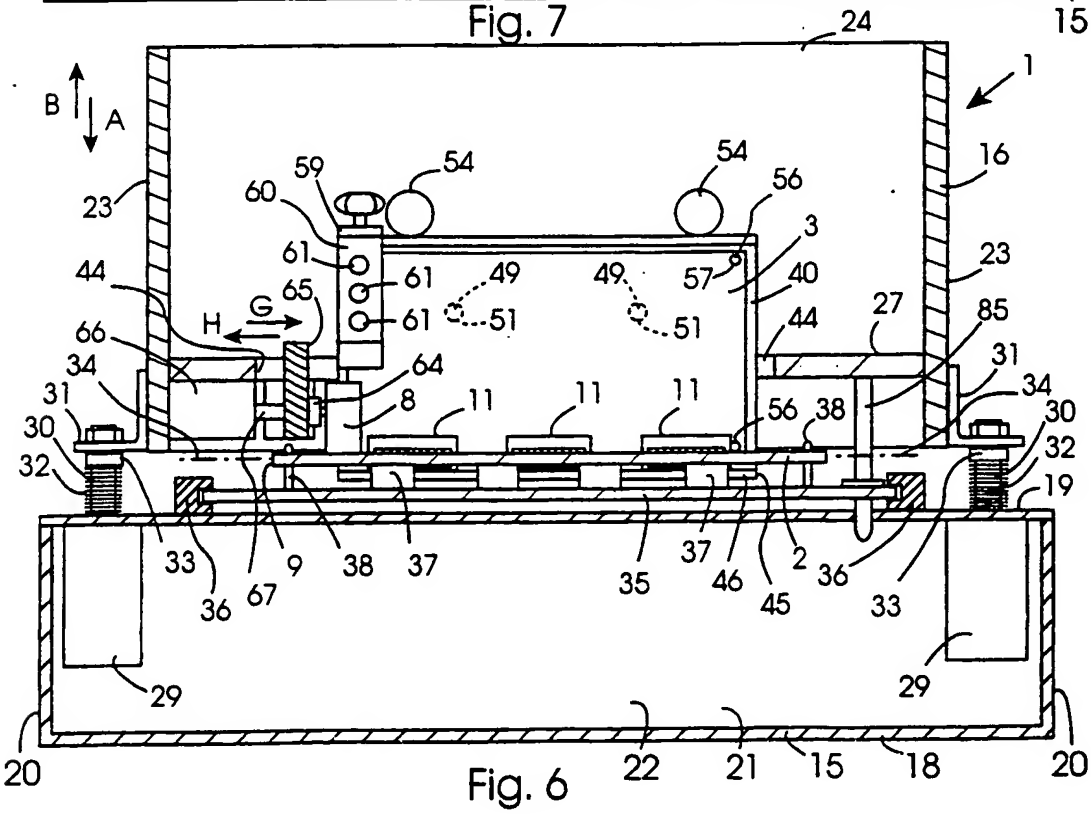
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Fig. 6

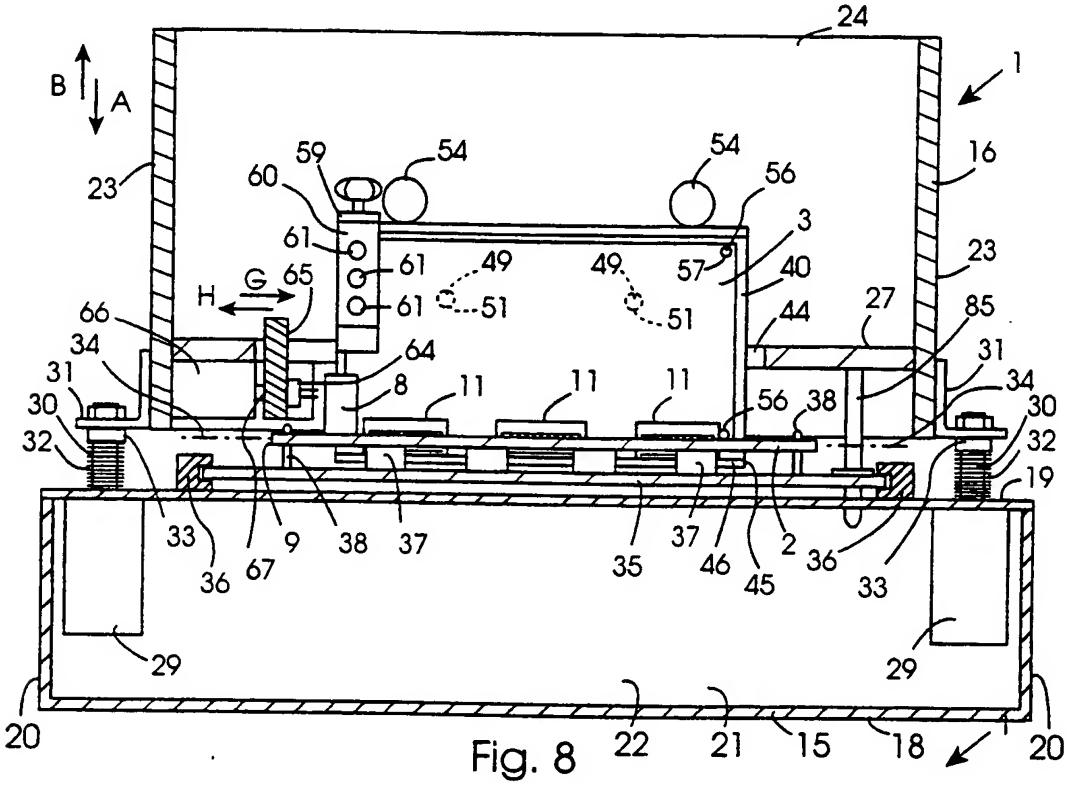
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Fig. 8

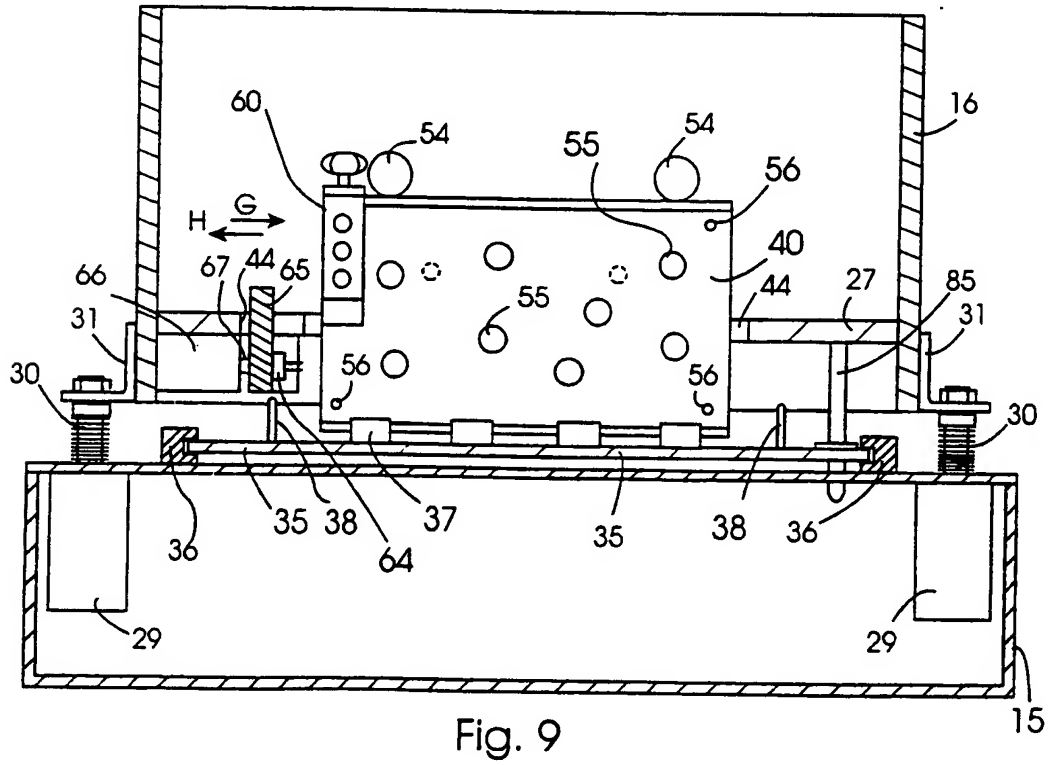
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Fig. 9

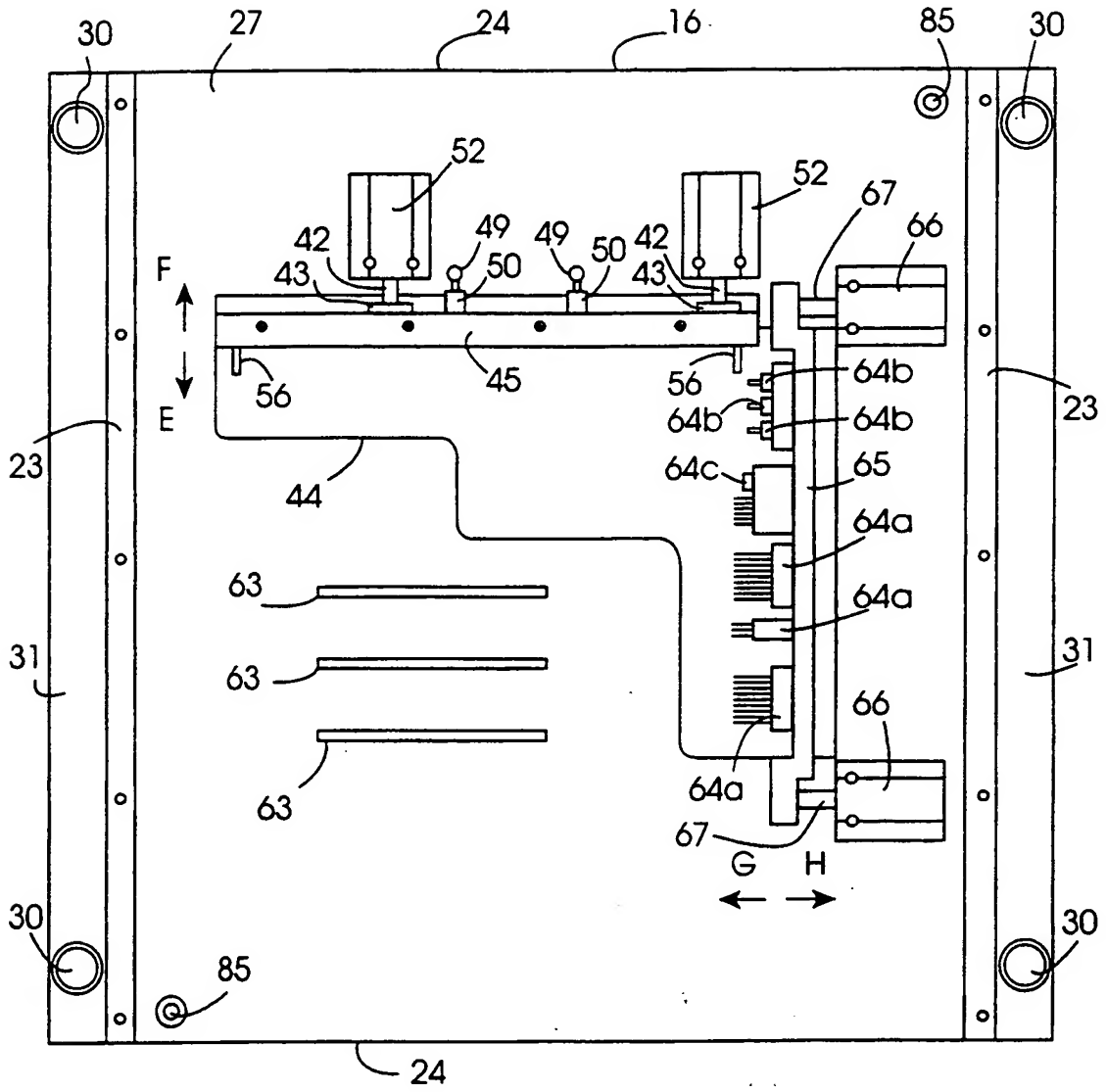
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Fig. 10

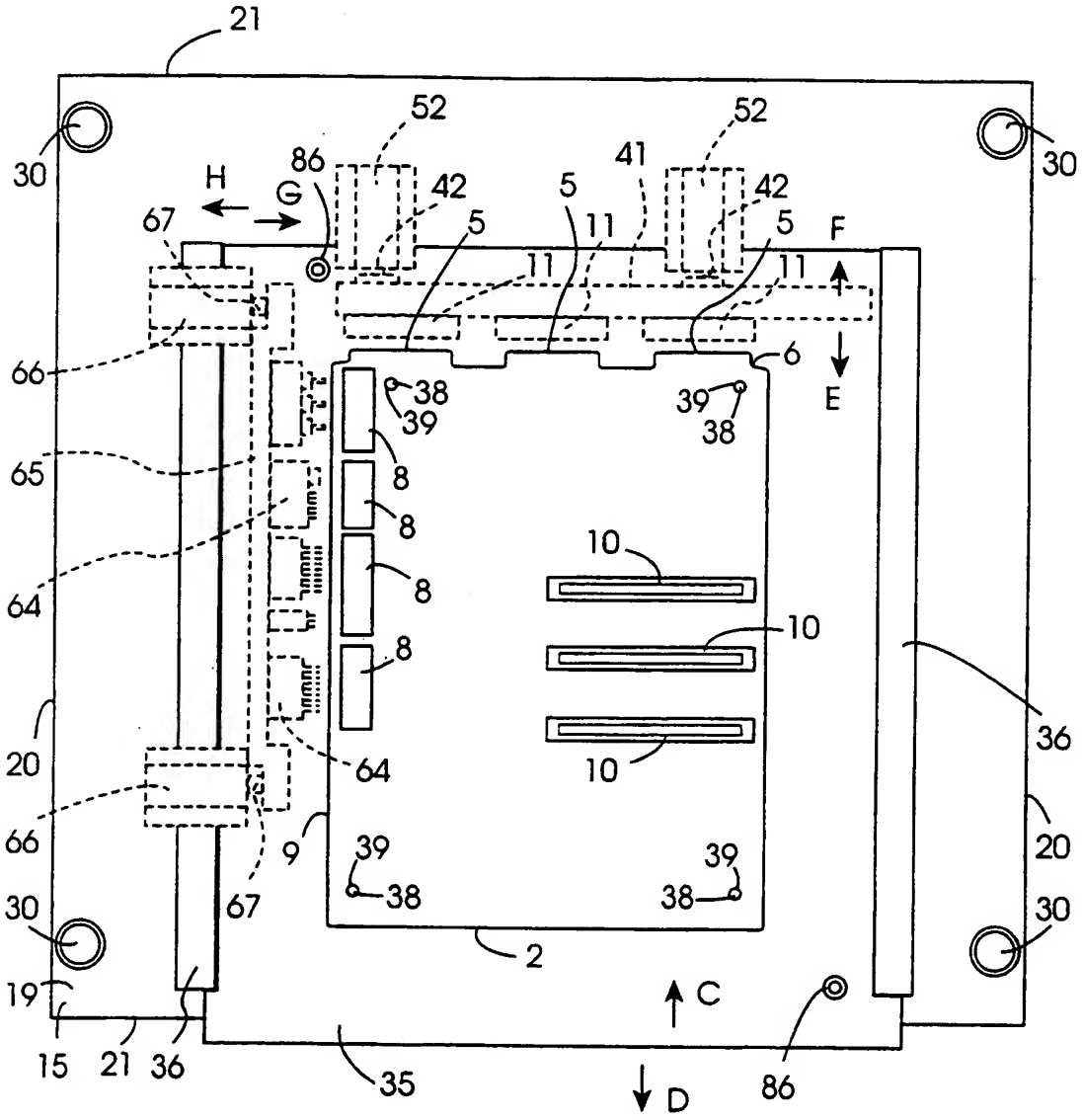
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Fig. 11

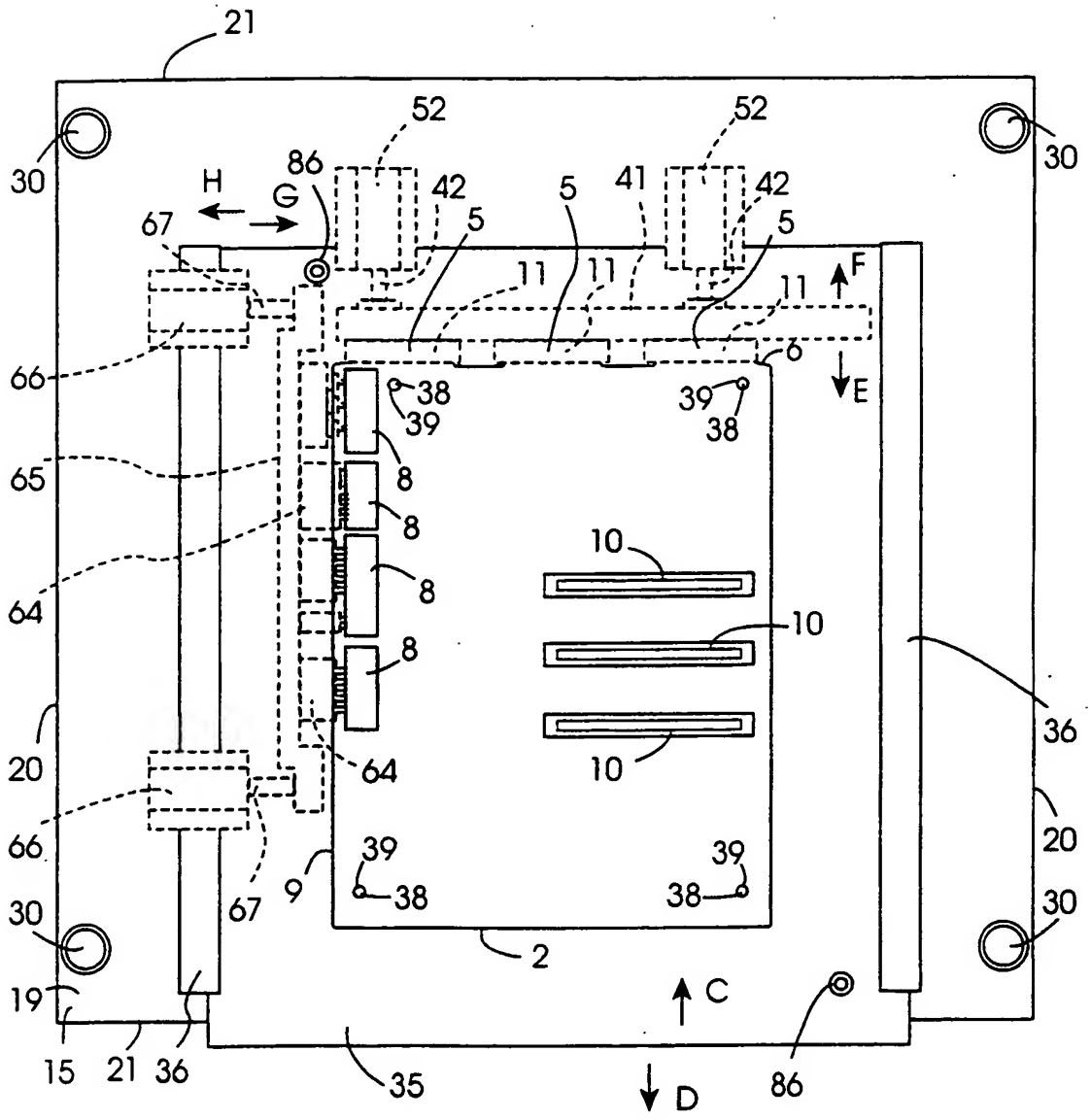
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Fig. 12

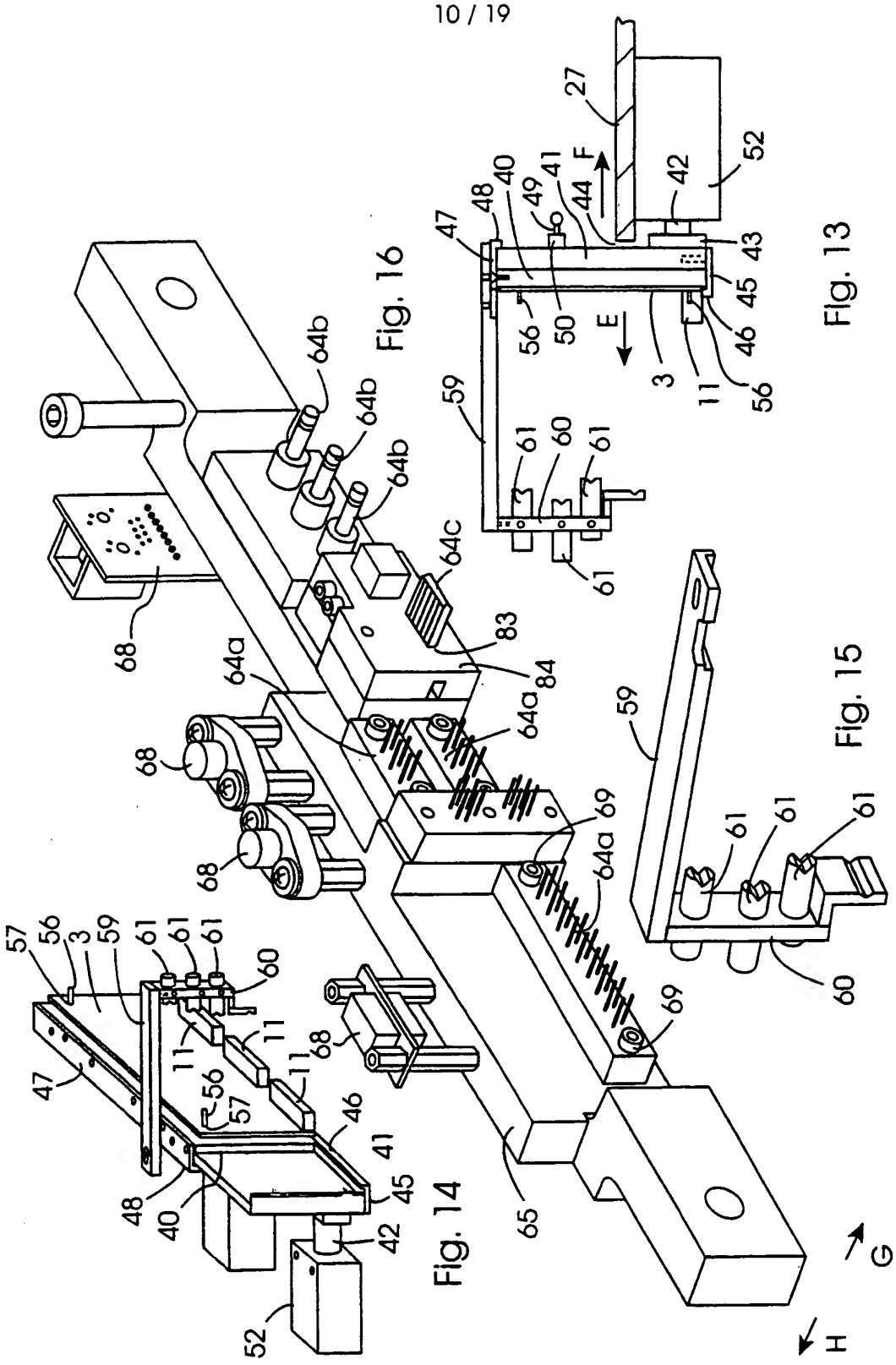
Fig. 13
Fig. 14
Fig. 15
Fig. 16
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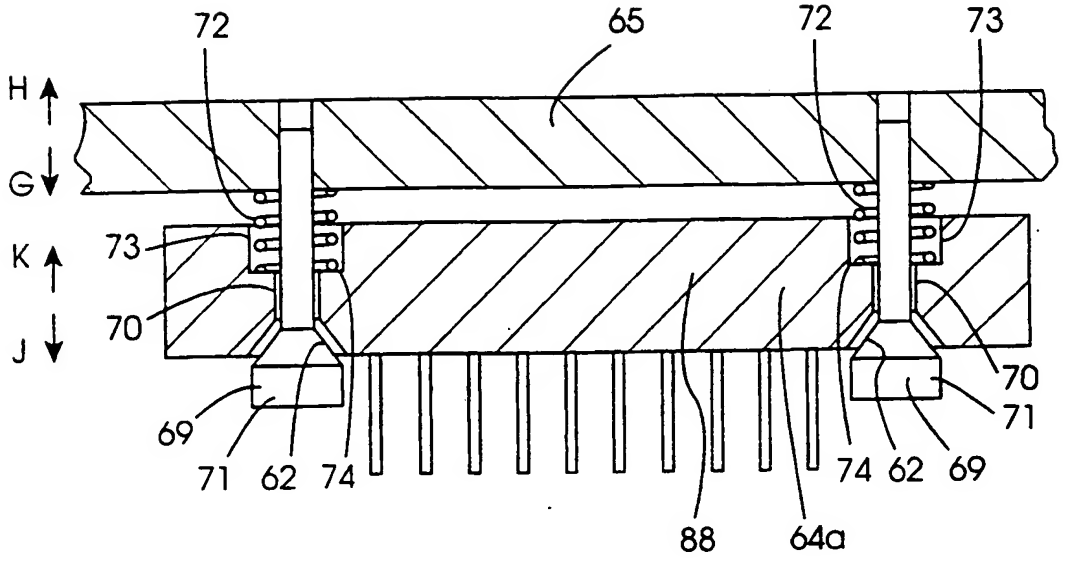
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Fig. 17

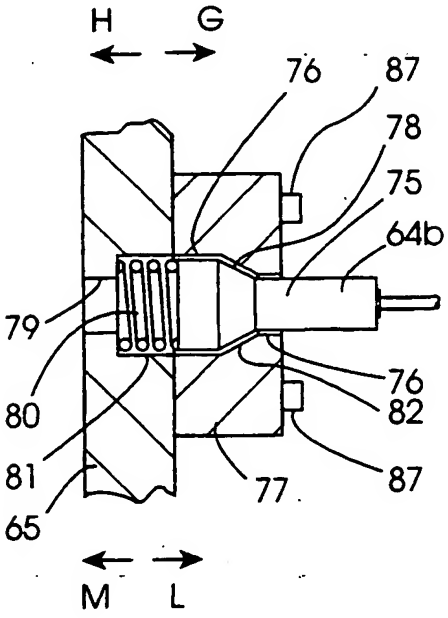
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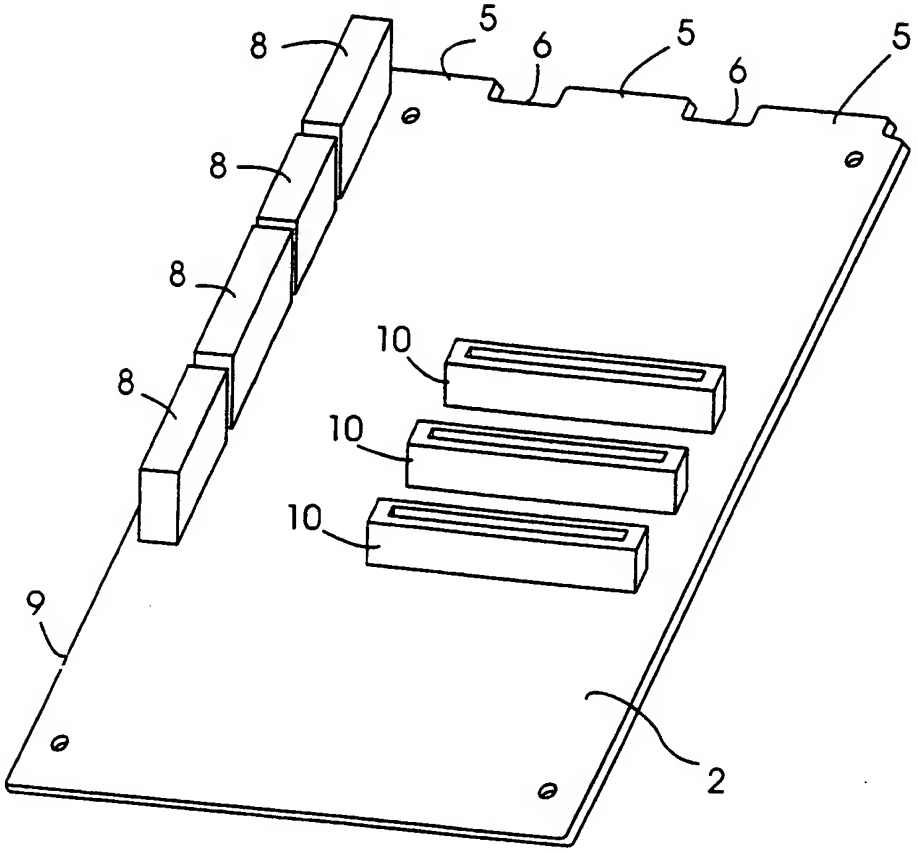
Fig. 18



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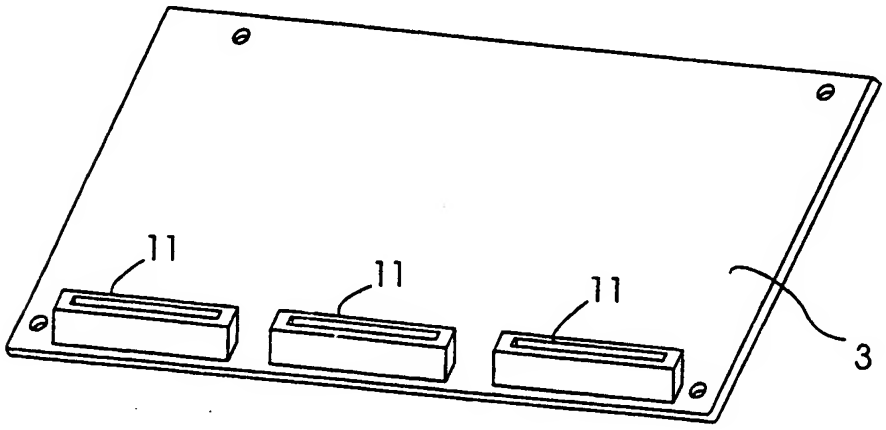

Fig. 20

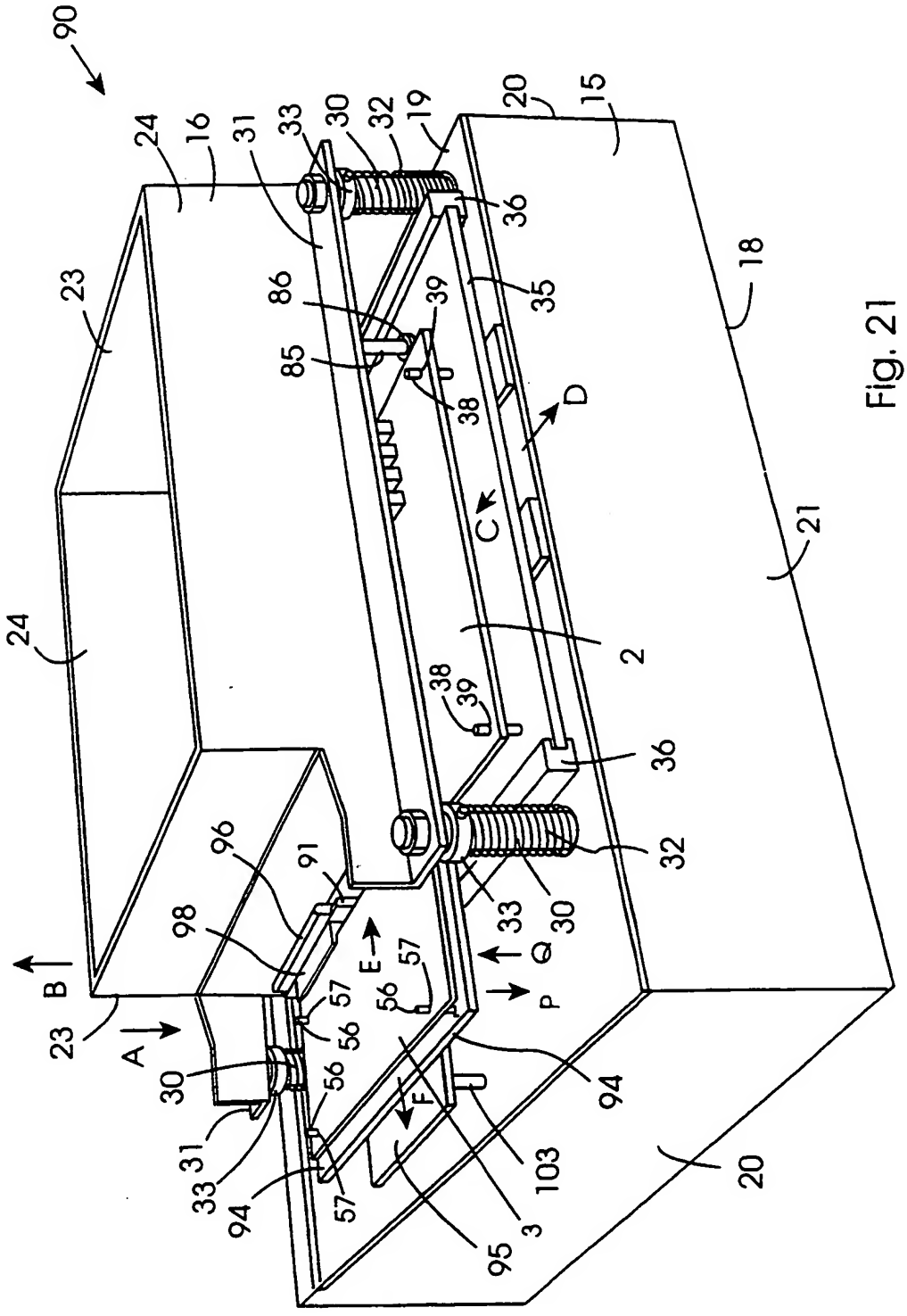
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Fig. 21

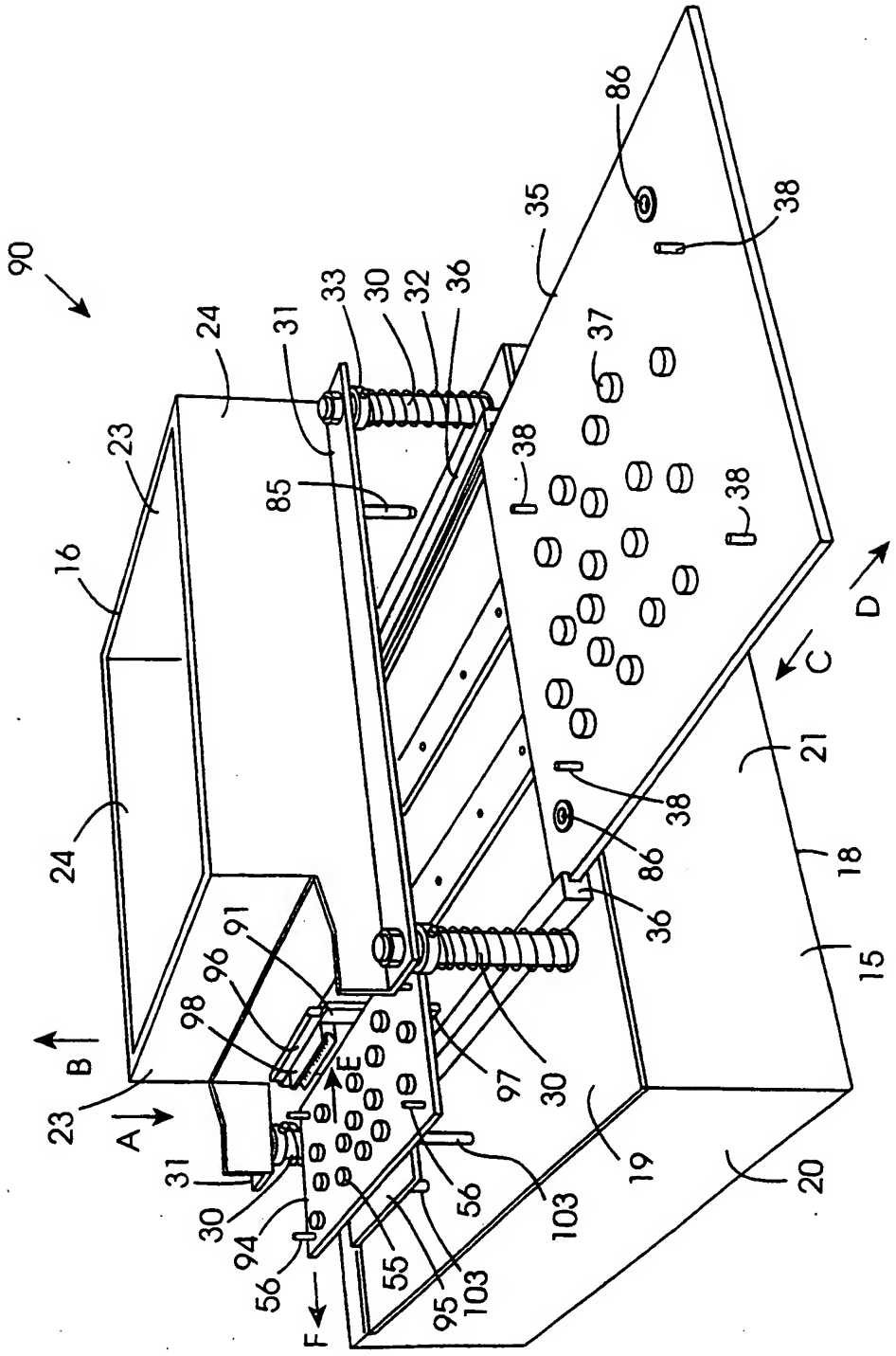
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Fig. 22

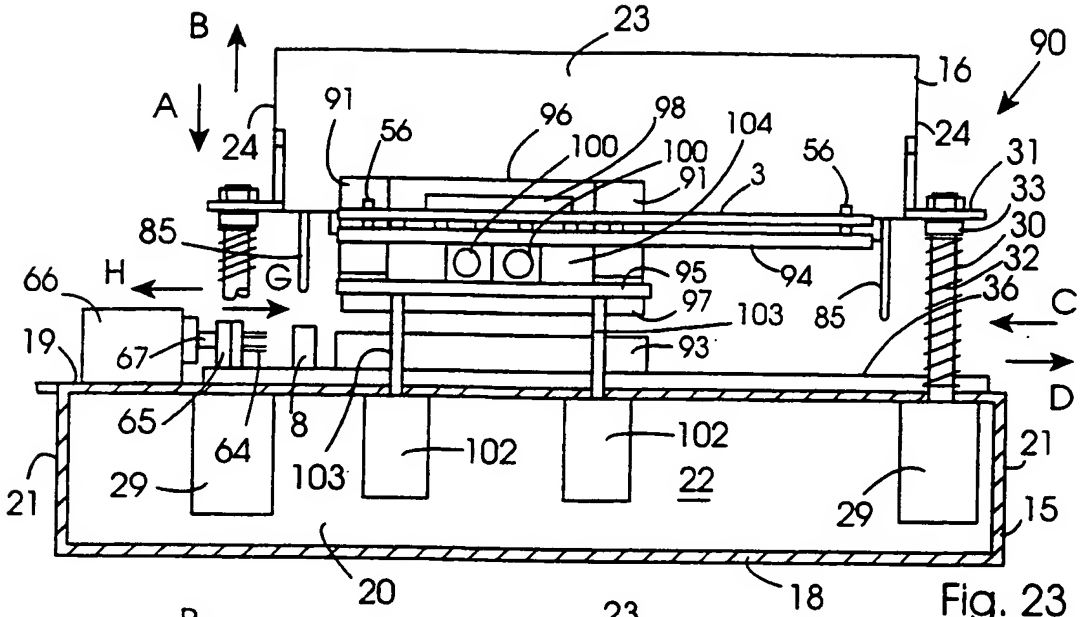
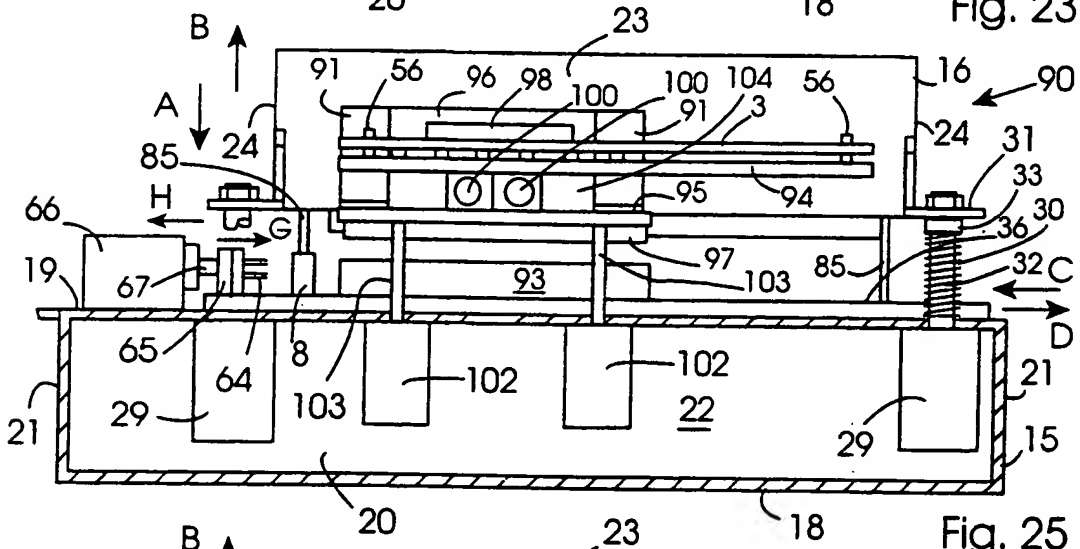


Fig. 23



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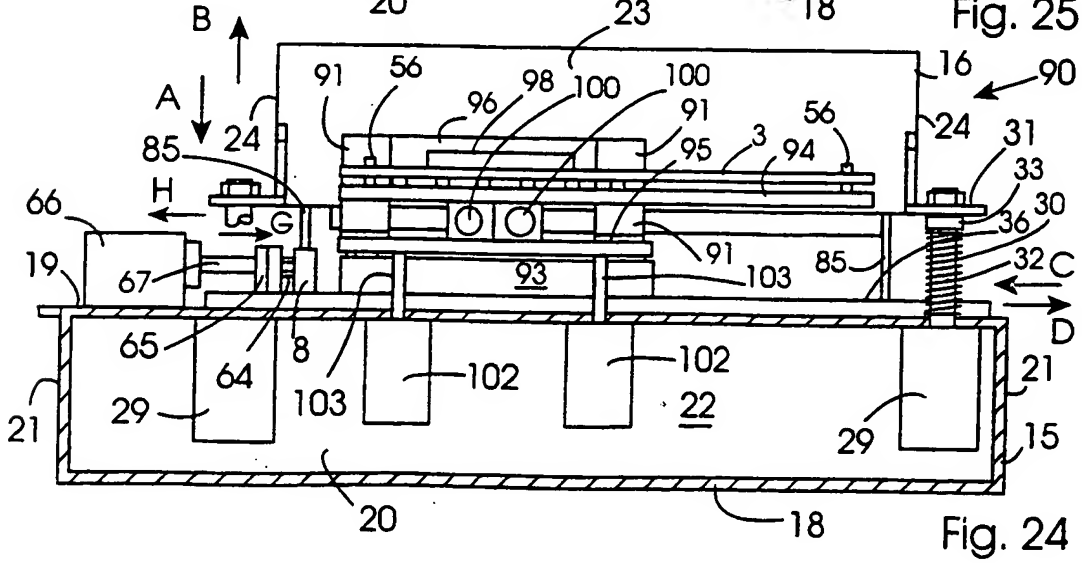


Fig. 24

BNSDOCID: <WO 9825152A1 I >

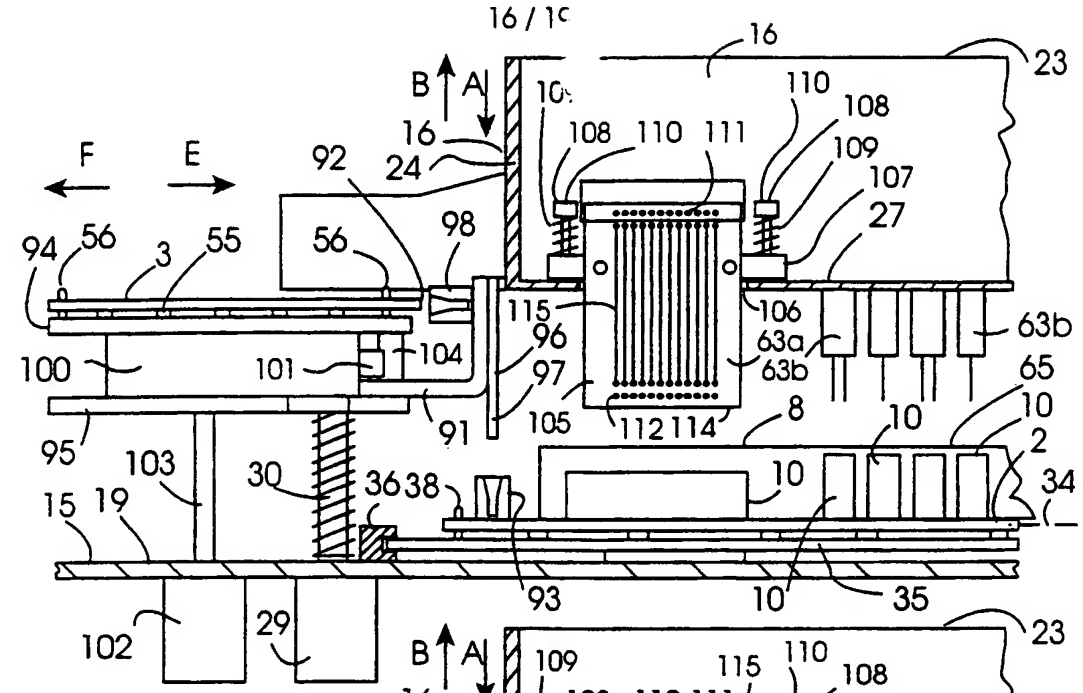


Fig. 26

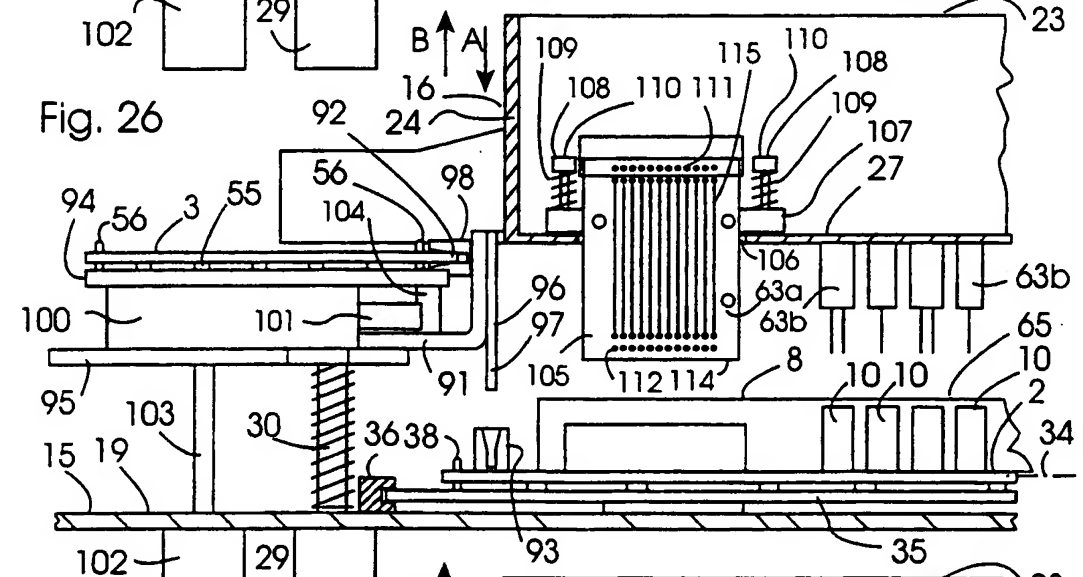
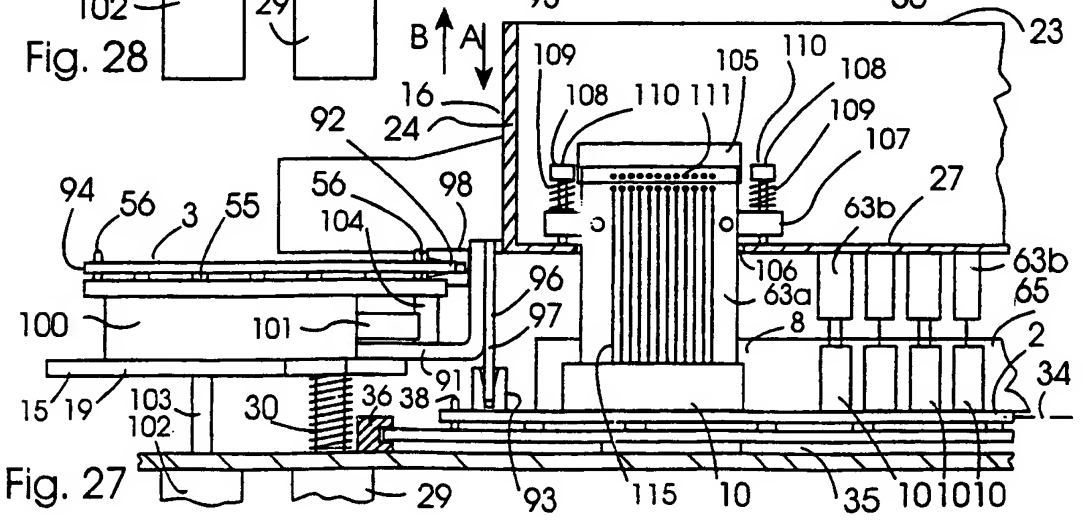


Fig. 28



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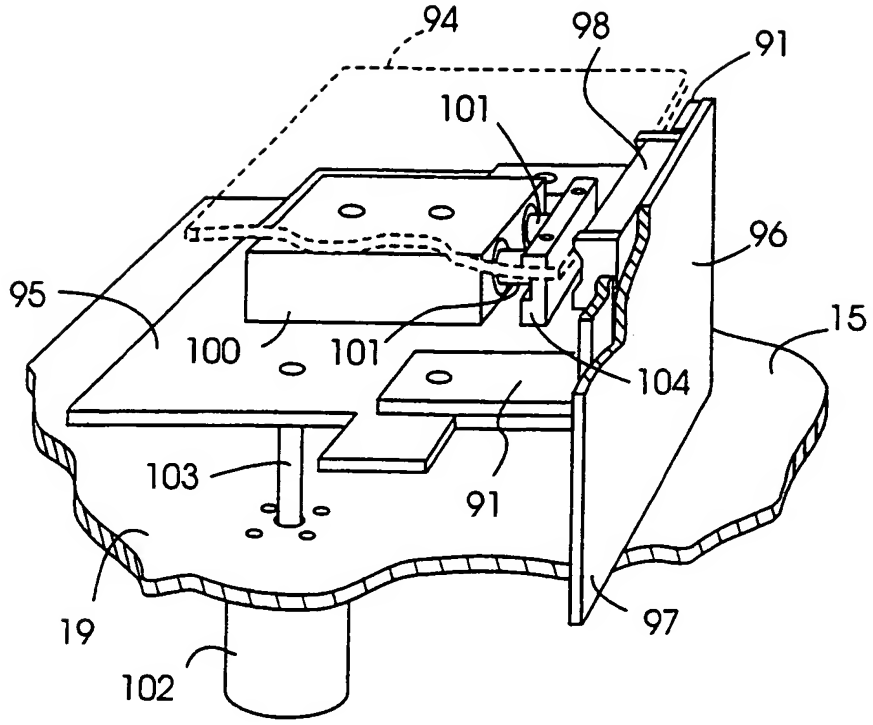

Fig. 29

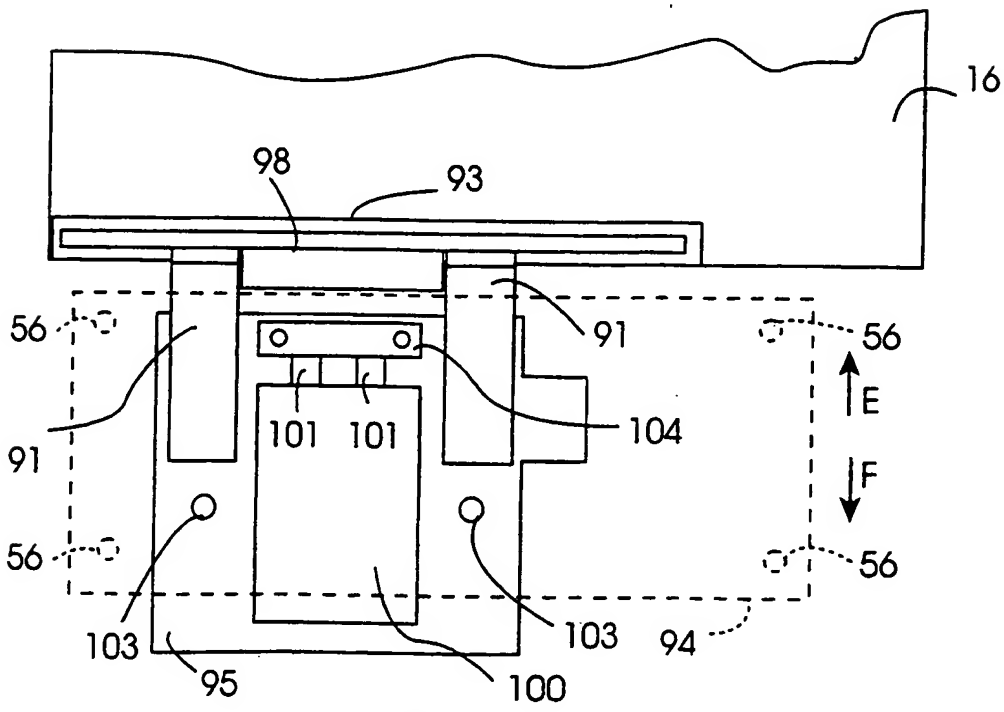

Fig. 30

BNSDOCID: <WO 9825152A1 >

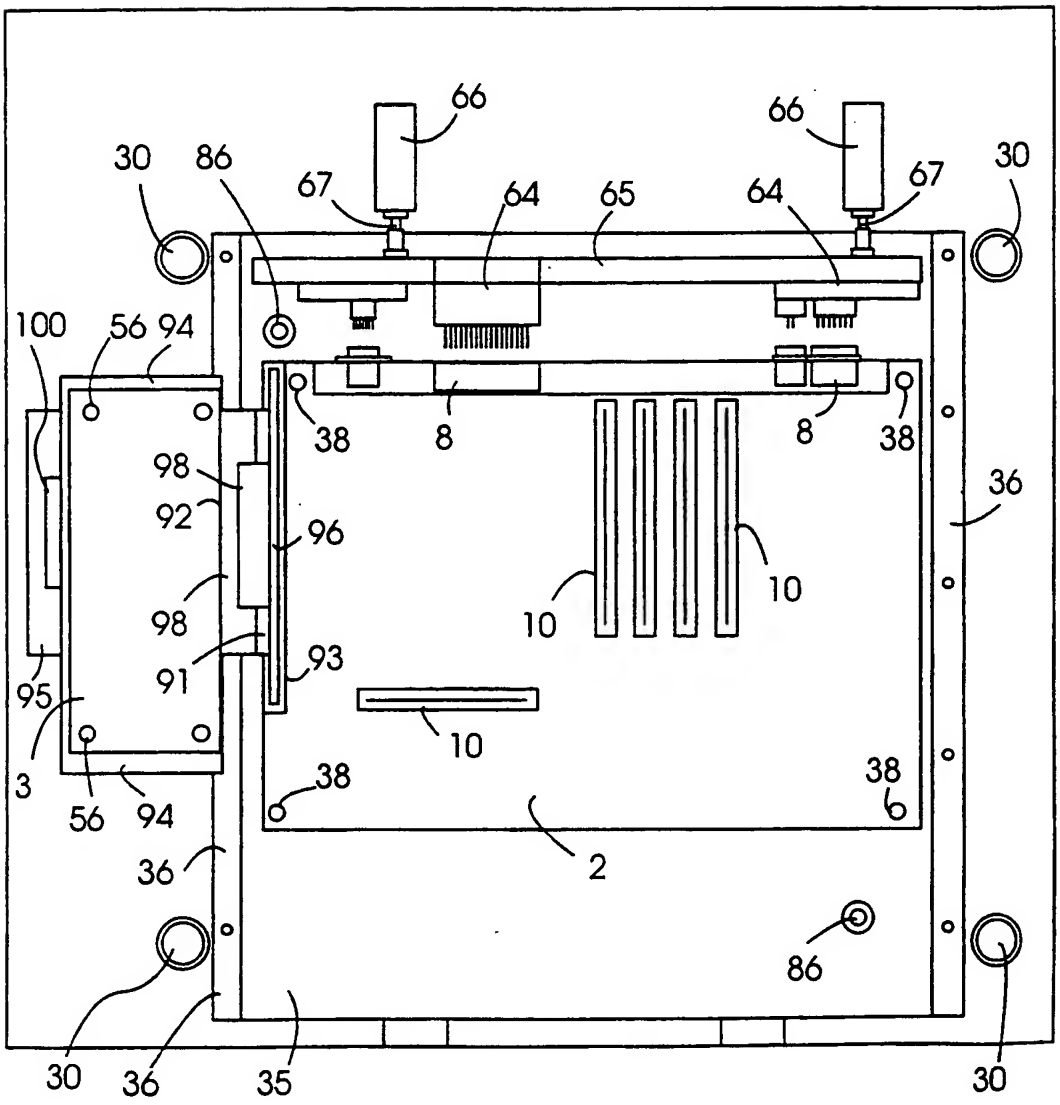
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Fig. 31

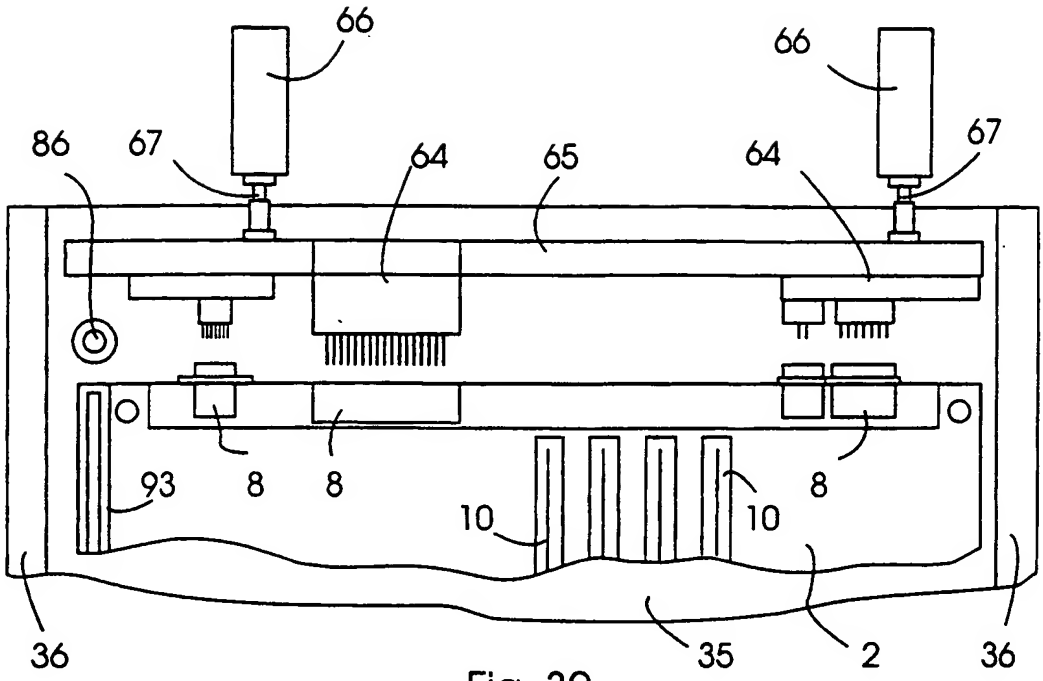

Fig. 32

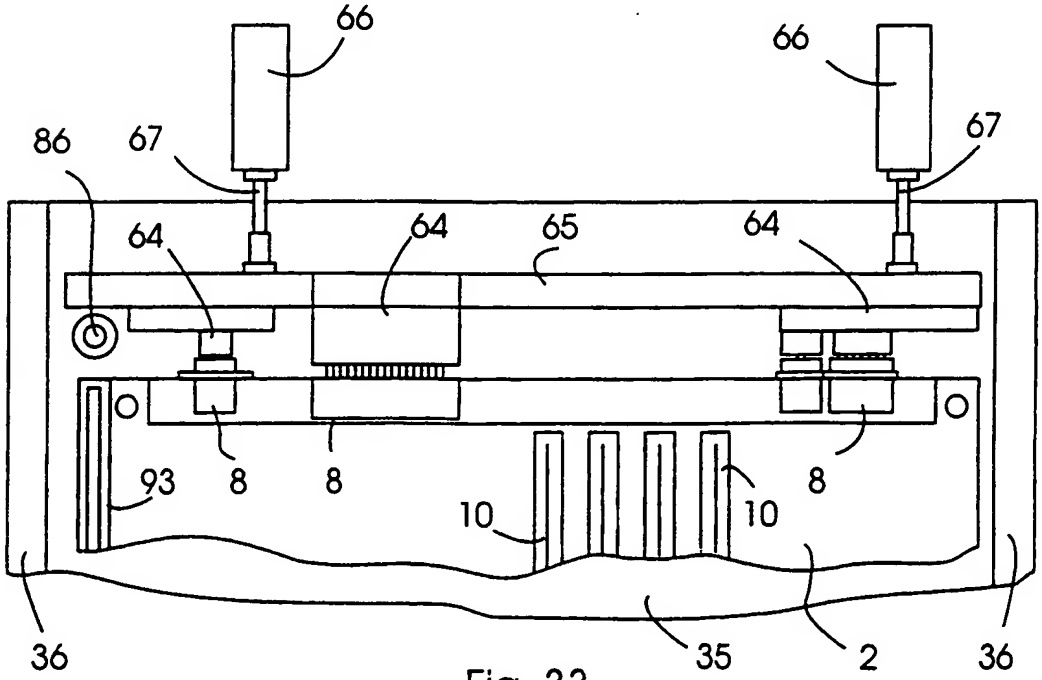

Fig. 33

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INTERNATIONAL SEARCH REPORT

Inter[illegible]nal Application No
PCT/IE 97/00081

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 G01R31/28

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 G01R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	B. N. EATON: "circuit board tester" IBM T.D.B., vol. 18, no. 11, April 1976, page 3551 XP002059090 see page 3551, paragraph 1-2 ---	1
A	US 4 758 780 A (COON ET AL.) 19 July 1988 see claim 1; figure 1 ---	1
A	US 4 626 780 A (POWERS ET AL.) 2 December 1986 see figure 2 -----	1

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☒ Patent family members are listed in annex.

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1

Date of the actual completion of the international search	Date of mailing of the international search report
17 March 1998	27/03/1998

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Hoornaert, W

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INTERNATIONAL SEARCH REPORT

ormation on patent family members

Inter[illegible]al Application No
PCT/IE 97/00081

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4758780 A	19-07-88	NONE	
US 4626780 A	02-12-86	NONE	

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